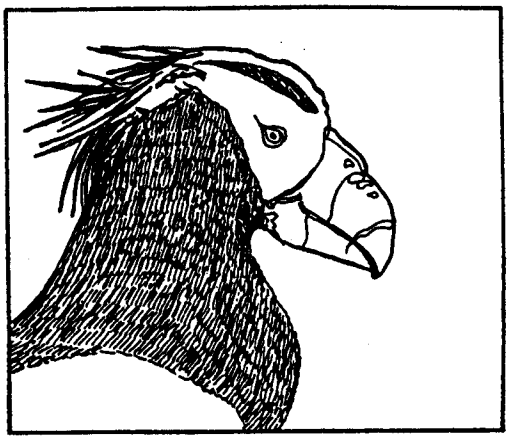
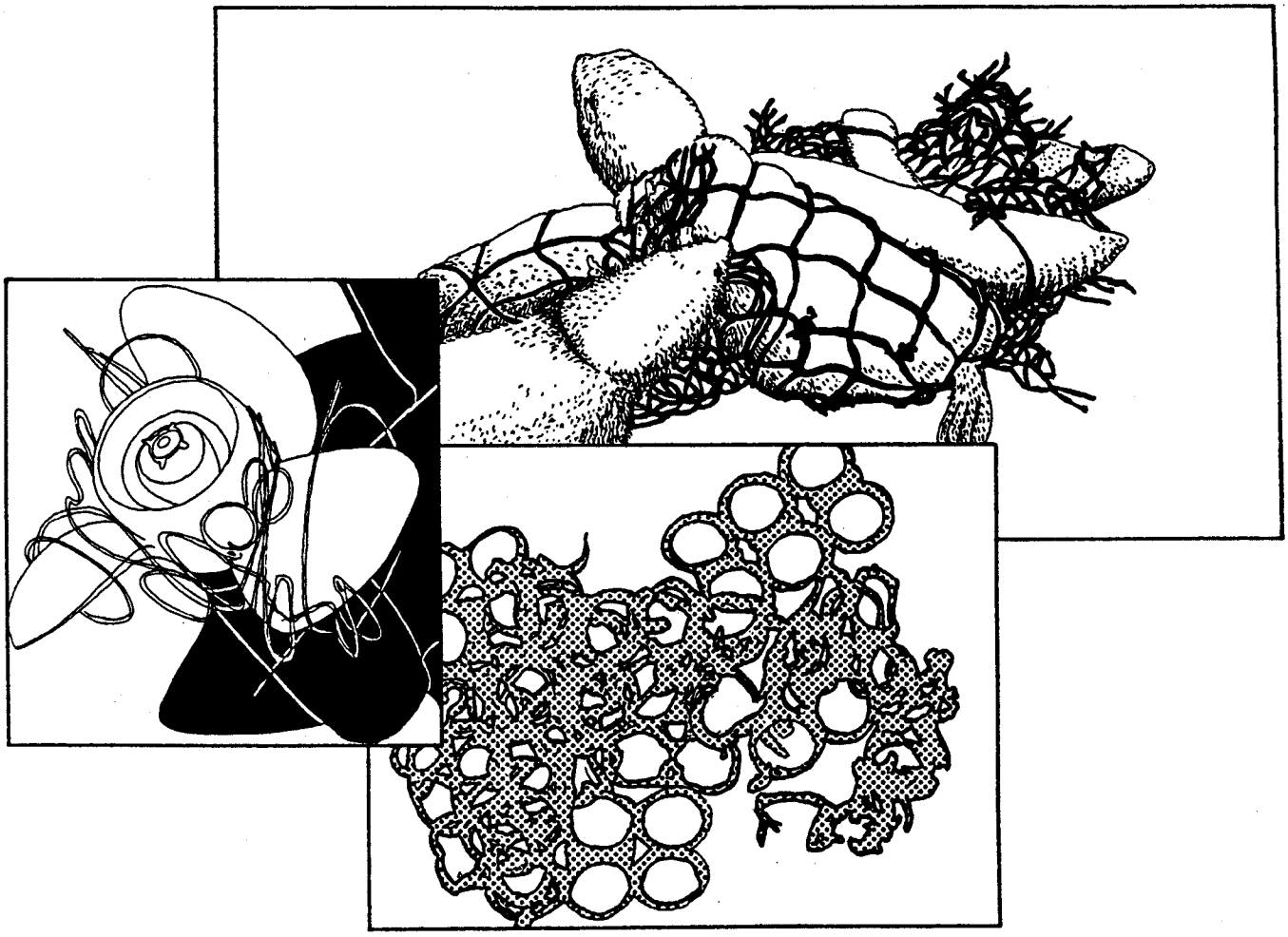
SESSION VII



SOLUTIONS THROUGH EDUCATION



THE PLASTICS INDUSTRY AND MARINE DEBRIS: SOLUTIONS THROUGH EDUCATION

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ABSTRACT

Over the past several years, intense media attention and congressional debate have focused on the problems caused by plastics discarded or lost in the marine environment. Less well known are the efforts of the plastics industry, through its major trade association, The Society of the Plastics Industry, Inc. (SPI), to help find solutions to these problems. Since 1986, SPI has been working with the Center for Marine Conservation--formerly the Center for Environmental Education--and the U.S. National Oceanic and Atmospheric Administration to implement public service educational campaigns with specific messages targeted to selected audiences.

When the marine debris problem is examined in detail, it is clear that among the various types of plastic debris, all but one end up in the oceans as the result of activity by individuals beyond the "control" of the plastics industry. The one exception involves resin pellets, the raw material for making plastics products. This presentation will examine how the plastics industry has responded to the marine debris problem in general, and specifically to the presence of resin pellets in the aquatic environment.

INTRODUCTION

Over the past several years, intense media attention and congressional debate have focused on problems caused by plastics that have been intentionally discarded or accidentally lost in the marine environment. Less well known are the efforts of the plastics industry, primarily through its major trade association, The Society of the Plastics Industry, Inc. (SPI), to help find solutions to these problems.

Since 1986, SPI has been working with the Center for Marine Conservation (CMC)--formerly the Center for Environmental Education--and the U.S. National Oceanic and Atmospheric Administration (NOAA) to develop and implement a public service educational campaign with very specific messages

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In R. S. Shomura and M. L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, 2-7 April 1989, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFSC-154. 1990.

targeted to selected audiences. This paper will examine that segment of the public service campaign targeted to the plastics industry, as well as other activities aimed at educating plastics companies about the role of discarded plastics in the marine environment and what should be done about them.

THE SOCIETY OF THE PLASTICS INDUSTRY POLICY STATEMENT

The SPI's educational efforts have been strongly backed at the highest levels of the organization. Their board of directors developed and passed on 18 September 1987 an official policy statement on marine debris that pledged the industry to help solve the problem.

That policy stated, in part:

"The SPI supports the responsible use of its industry's materials and proper disposal of those products when they become waste. Plastics should not be discarded into the ocean or any other body of water.

- "Plastics Resin Pellets--The SPI is dedicated to working with its member companies to eliminate circumstances that result in resin pellets being lost in manufacturing or transportation and possibly rendering harm to animal or marine life that mistake the pellets for food.

- "MARPOL Ratification--The SPI supports U.S. ratification and implementation of the Annex V of the MARPOL Convention, which would prohibit the dumping of plastics waste into the ocean.

- "Degradability--The SPI endorses continued research and development on degradable plastics. However, it believes there are limitations on what products are suitable to be made degradable. Performance and safety requirements should not be compromised in order to make a product degradable. . . .

- "Public Education--The SPI supports public education encouraging the proper disposal of plastics and other materials as the most effective way to reduce harm to the marine environment. The association is willing to work with other organizations sharing this position on projects to further education on the proper disposal of plastics in the marine environment."

In addition, SPI invited CMC President Roger McManus to make a special presentation on the subject to its board of directors' Issues Management Committee on 12 May 1988, and CMC staffer Kathy O'Hara has addressed the SPI Issues Communication Committee and other industry audiences on several occasions. These presentations were particularly helpful in raising the level of sensitivity and responsiveness within the industry.

THE SOCIETY OF THE PLASTICS INDUSTRY SUPPORTS MARPOL ANNEX V

In 1987, when the U.S. Congress was considering ratification of Annex V, many organizations--including the plastics industry--spoke out in support of it. The SPI was emphatic in its view that the time has come to stop discarding trash of all kinds into the marine environment. Testifying before a subcommittee of the U.S. Senate Committee on Environment and Public Works, SPI's Lew Freeman, vice president of government affairs, said:

> ". . .To the extent that plastics are part of the marine debris problem the SPI and the plastics industry will continue to work with government, environmental groups, and other industries to develop responsible and effective solutions. But marine debris is more than just a problem of 'plastics pollution,' the term so frequently used to describe it. It is a broader problem of debris from all types of materials being discarded in the oceans.
>
> "There will be a marine debris problem with or without plastics as long as a growing and affluent world population continues the overt--and sometimes covert--practice of using the oceans of the world as a convenient place to put waste. . . . Clearly, plastics waste does not belong in the oceans. However, neither do glass, metal or even paper wastes" (Freeman 1987).

RESIN PELLETS

When the scope of marine debris is examined in detail, it is clear that the problem stems from many sources. In the CMC's 1987 report for the U.S. Environmental Protection Agency, at least nine distinct sources were identified: commercial fishing operations, merchant shipping, naval and research vessels, plastics manufacturing, offshore drilling operations, recreational boaters, docks and marinas, municipal stormwater and sewage systems, and general littering by beachgoers. All but one of these "sources" are the result of activities that are beyond the sphere of direct influence of the plastics industry. That one exception involves resin pellets, the raw material for making plastics products.

Resin pellets, while not particularly an aesthetic problem in the marine environment, have been identified as a hazard to seabirds who ingest them. Although resin pellets are not as abundant as other debris items in the ocean, they seem to be preferred by seabirds. In studies of plastic pieces in the North Pacific (Wilbur 1987), only 0.5% of the pieces of plastic collected from surface waters were pellets. Yet these pellets form about 70% of the plastic found in the stomachs of seabirds.

BRIEFING FOR RESIN PELLET PRODUCERS

One of SPI's first steps in dealing with the question of resin pellets in the marine environment was to alert companies that produce these materials. In September 1986, SPI hosted a briefing in Washington, D.C. which

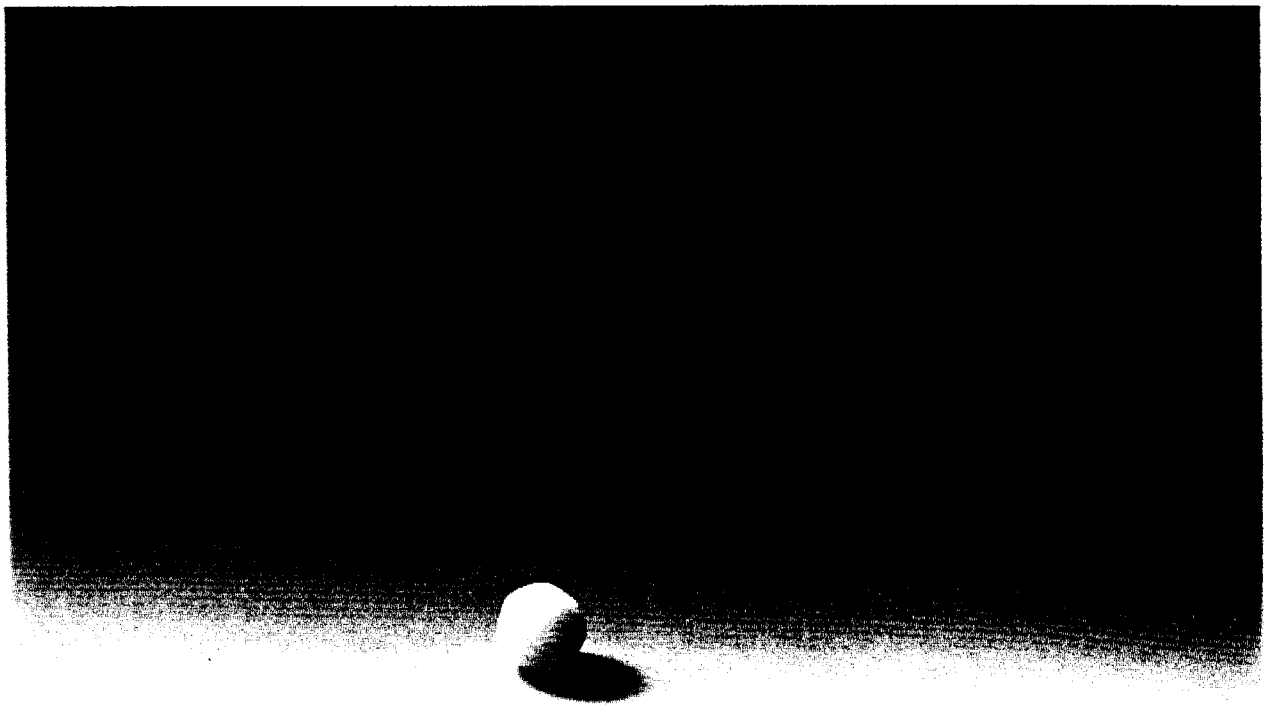
featured a presentation by Kathy O'Hara from CMC on the marine debris problem and a videotape on resin pellet reclamation produced by Dow Chemical Co., an SPI member company. Virtually all the major resin-producing companies sent representatives. Discussions at that meeting yielded insights that later would be incorporated into a variety of public service materials. The foundation also was laid for an informal survey of the pellet-handling practices of resin producers. While not a definitive study, the results showed that containment procedures for handling resin pellets generally were implemented in the early-to-mid-1970's and that current practices at resin plants seem to preclude significant losses into the environment. Less was known about the thousands of companies that process the resin pellets into final products; thus materials were developed to inform them of the problem as well as of corrective actions to be taken.

PUBLIC SERVICE ADS AND BROCHURES

As noted in the Introduction, the plastics industry was one of three audiences initially targeted by the SPI/CMC/NOAA public service campaign. Materials developed under the joint logo included a full-page, black-and-white magazine ad (Fig. 1) for use in plastics industry publications and an eight-panel collateral brochure. The ad, which shows an enlargement of a resin pellet, carries the headline "A seabird could mistake this resin pellet for a fish egg. And die." The copy reads:

> "One little pellet may be insignificant to your plastics processing operation. But to thousands of seabirds, it could lead to a fatal error.
>
> "These pellets, in many shapes and sizes, can be washed down drains as waste or reject material, or spilled in the course of normal handling. But ultimately, they may find their way to bodies of water, where the real trouble begins.
>
> "When eaten in sufficient quantity by a seabird, they can block digestion or sometimes fool the bird into thinking it is not hungry, causing eventual starvation. Fish and sea turtles can suffer the same fate.
>
> "The growing problem of plastic trash in our oceans threatens more than wildlife. This critical issue is destined to invite increasing public and government scrutiny unless we take action to solve it.
>
> "So please: see that resin pellets are reclaimed or disposed of properly. If we ignore the problem we--like the unfortunate seabird--will be making a serious mistake."

Camera-ready reproduction materials (negatives and veloxes) were made available free-of-charge to plastics trade publications, and readers of the ad were invited to write to SPI for additional information. Initially, that consisted of an eight-panel brochure, which offered these recommendations:



A seabird could mistake this resin pellet for a fish egg. And die.

One little pellet may be insignificant to your plastics processing operation. But to thousands of seabirds, it could lead to a fatal error.

These pellets, in many shapes and sizes, can be washed down drains as waste or reject material, or spilled in the course of normal handling. But ultimately, they may find their way to bodies of water, where the real trouble begins.

When eaten in sufficient quantity by a seabird, they can block digestion or sometimes fool the bird into thinking it is not hungry, causing eventual starvation. Fish and sea turtles can suffer the same fate.

The growing problem of plastic trash in our oceans threatens more than wildlife. This critical issue is destined to invite increasing public and government scrutiny unless we take action to solve it.

So please: see that resin pellets are reclaimed or disposed of properly. If we ignore the problem, we—like the unfortunate seabird—will be making a serious mistake.

To learn how you can help, write: The Society of the Plastics Industry, 1275 K Street, N.W., Suite 400, Washington, D.C. 20005.

A public service message from:
The Center for Environmental Education
The National Oceanic and Atmospheric Administration
The Society of the Plastics Industry

Figure 1.--Full-page public service ad developed for plastics industry publications has been published more than 25 times. Value of the donated space exceeds $100,000.

- Conduct an "audit" of manufacturing facilities to seek out and eliminate practices which could allow pellets to escape into the environment.

- Initiate an awareness and information program within the company.

- Install closed-loop pellet containment and collection systems in resin production facilities.

- If resin pellets are spilled during processing, clean them up promptly and either recycle them or dispose of them in ways that prevent their release into the environment.

- When cleaning hopper cars, do not flush residual pellets into the environment.

- Instruct employees to close valves on the unloading shoes of rail cars and hopper trucks after they have been unloaded. (If left open, small quantities of pellets stuck in the corners may vibrate loose and be scattered along railroad tracks and highways, ready to be washed by rain into the nearest stream.)

- Do not store or dispose of pellets in areas subject to flooding.

- Make sure resin pellets are used only as intended--for manufacture of plastics products.

Subsequently, a 20-piece marine debris information kit (described in detail on the following pages) was provided to all who wrote or called for more information. Individual companies also prepared materials. Dow Chemical Company produced and made available a videotape as well as a special flyer on resin pellet containment procedures.

PLASTICS MEDIA BRIEFINGS

Upon completion of the public service ad, brochure, and a special flip-chart presentation, a two-person SPI/CMC team set out to inform editors and publishers of major plastics industry publications on the importance of the marine debris issue. During the fall of 1987, the briefing team personally met with Bob Martino, editor, and Bob Leaversuch, senior editor, at Modern Plastics; Doug Smock, editor, at Plastics World; Matt Naitove, editor, and Bob Burns, associate editor, Plastics Technology; Bob Forger, publisher, and Abe Schoengood, editor, Plastics Engineering; and Peter Sullivan, group vice president, Suzanne Witzler, executive editor, and Mel Friedman, editor, of Edgell Publications (formerly HBJ Publications, which includes Plastics Machinery and Equipment, Advanced Composites, Plastics Compounding, Plastics Design Forum, and Plastics Packaging). The readers of these publications represent a "Who's Who" in plastics, reaching virtually every segment of the industry.

In each case, the overall marine debris problem was discussed with emphasis on the resin pellet aspect, and the publication was asked not only to write about it but also publish the ad on a public service basis.

PLASTICS MEDIA RESPONSE

The response to the visits by the briefing team was overwhelming, and some publications continue to run the ad nearly 18 months later. (In the summer of 1988, two smaller versions of the ad were developed and reproduction materials provided to each of the publications.) Through February 1989, plastics industry publications have devoted more than 1,000 column inches of space either to the ad or to news coverage of the marine debris issue. The ad alone has been published on at least 25 occasions by 10 different publications. Their combined circulations in conjunction with the number of publication times means that more than 1.1 million magazine pages featuring the resin pellet ad are now circulating within the plastics industry. It is estimated that the donated advertising space alone would have cost in excess of $100,000 had it been purchased at the regular rates.

Not only was the ad published with great frequency, but it also was read! Plastics Design Forum (circulation: 47,500 design engineers) reported that a Readex study of its January 1988 issue showed the resin pellet ad was "the second best read ad in the whole issue" (second only to a multipage, full-color special section). "I think that says a lot of things--both in terms of the quality of the ad, but maybe even more significantly, in terms of the importance of the message," commented Peter Sullivan in reporting the results of the study to SPI.

As gratifying as the advertising support has been by plastics industry publications, even more crucial has been their editorial endorsement of the need for the plastics industry to respond to the problem of plastics in the marine environment. Within months of the visits by the briefing team, four of the largest publications devoted their editorial pages (Fig. 2) to the subject. An example is this excerpt from Modern Plastics (Martino 1987, p. 41):

> "Goodbye, George F. Babbitt.--The era of Babbittry has ended--at least in plastics. Sinclair Lewis' fictional businessman might still find a home in the backwaters of industry, but here in the mainstream Babbitt's boosterism and distrust of skeptics no longer has an audience. We see this clearly in environmental issues. There is a new generation of plastics leadership--mindful that plastics surround citizens in daily life, pragmatic enough to listen to these citizens, and responsible enough to want to listen.
>
> "One hopes that the passing of Babbitt will be mirrored by the passing of those who have made it their personal mission to save the world from plastics. The need for cooperation between industry and citizens on environmental issues is so apparent that responsible people should no longer have patience with this sort of axe grinding. . . .

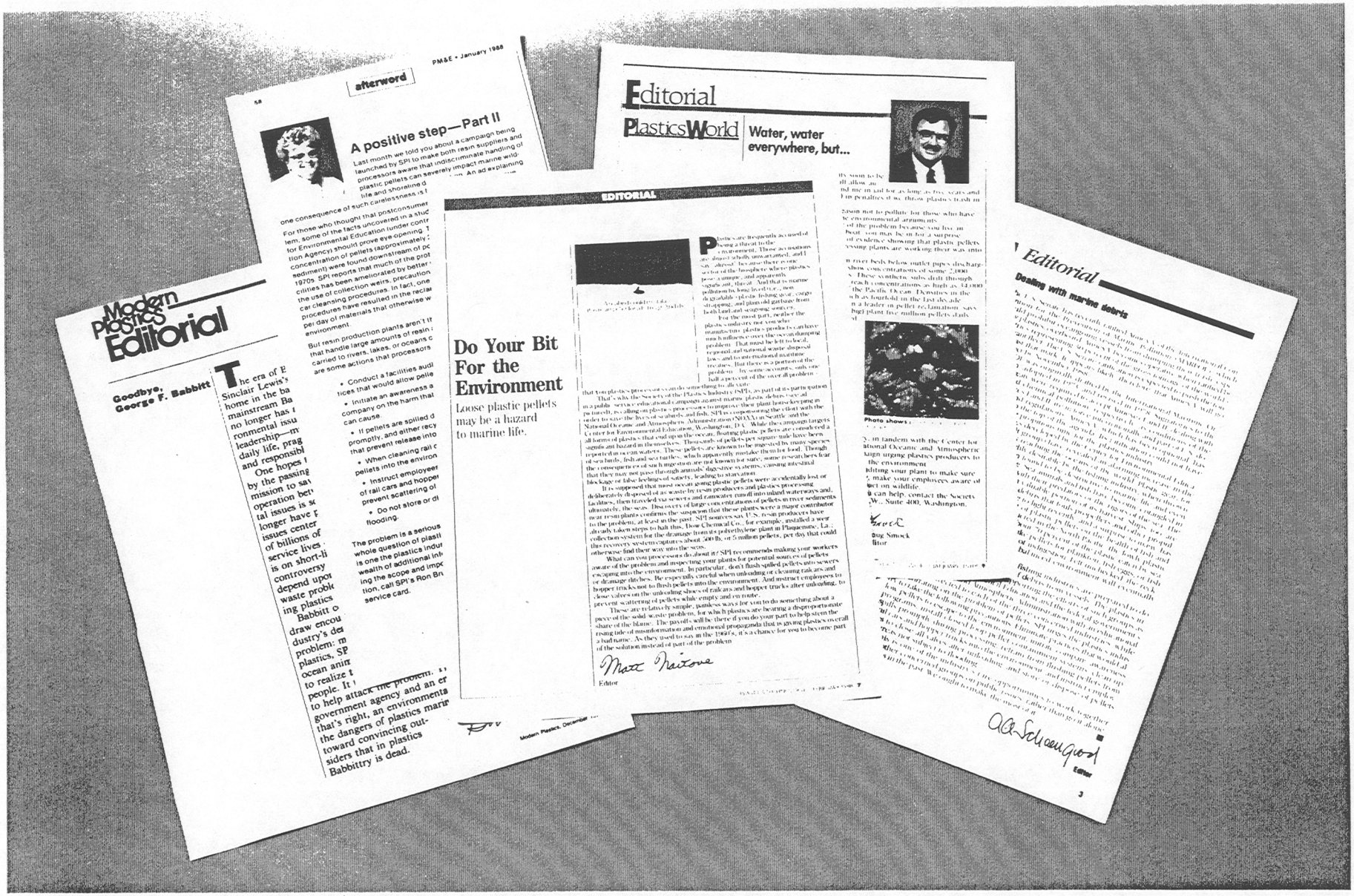


Figure 2.--All the major plastics industry publications wrote editorials calling attention to the marine debris situation and encouraging the industry to support corrective actions.

> "Babbitt could never have coped. We, however, can draw encouragement from the Society of the Plastics Industry's dealings with one special form of solid waste problem: marine litter. Instead of knee-jerk defense of plastics, SPI's response to reports that plastics litter kills ocean animals was to take the reports seriously enough to realize that they were accurate accounts from sensible people. It then undertook practical, reasonable measures to help attack the problem. The latest, joining with a government agency and an environmentalist group--that's right an environmental group--to warn about the dangers of plastics marine litter will go far toward convincing outsiders that in plastics Babbittry is dead" (Martino 1987).

Closer to home, SPI has published the full-page public service ad several times in its President's Report to the Members, distributed quarterly to 4,000 leading executives in the plastics industry. In addition, stories have been carried in that same publication as well as in Plastics News Briefs, also published by SPI and distributed to nearly 11,000 people in the industry.

PLASTICS MARINE DEBRIS EDUCATION KIT

While publication of the public service ads, editorials, and news stories in the plastics trade press was raising the awareness level of the issue within the industry, SPI was busy developing additional materials for use with its members. Those materials took the form of the Plastics Marine Debris Education Kit (Fig. 3), which was distributed in May 1988 to some 1,500 resin-producing and processor companies on SPI's membership list. The cover letter, distributed with the kit and signed by SPI President Larry Thomas, said in part:

> "As you know, the problem of plastics in the marine environment has gained widespread attention over the past year from both the media and government officials. For the most part, the situation is out of our hands--obviously it is difficult for us to keep track of how the end-user disposes of our products, and the vast majority of the plastics in the marine environment were dumped there by others.
>
> "But the problem of resin pellets in the ocean is ours alone.
>
> "It is time to escalate our education efforts to be sure that pellets are not escaping during routine handling, transportation and shipping procedures. . . . I urge you to make this education effort a priority. Employees who manufacture, ship and handle resin pellets need to become more aware of the importance of careful handling procedures. . . ."

The information kit, which carried the resin pellet theme from the public service ad and brochure, was designed to enable any company to carry out its own internal information campaign. Included in the kit were:

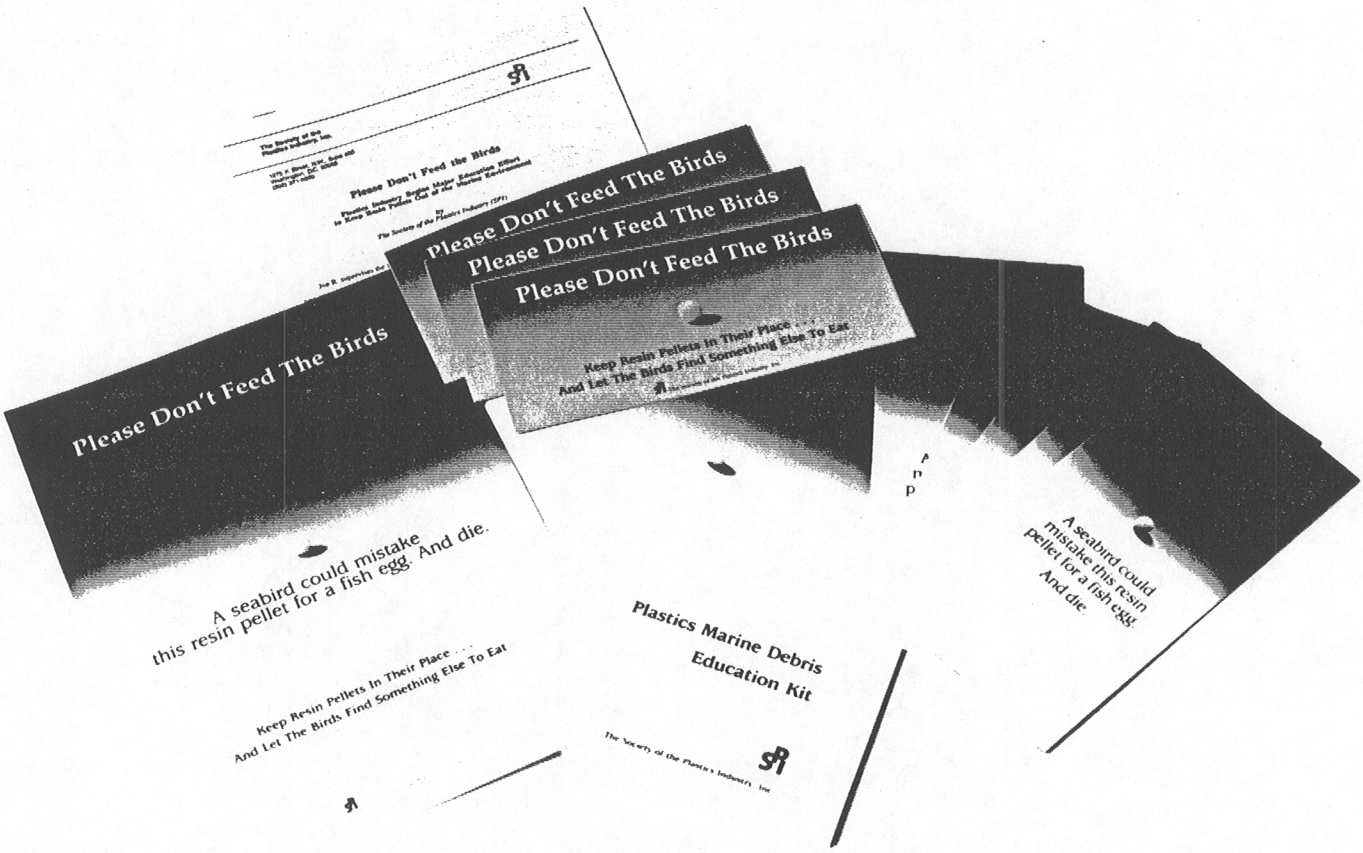


Figure 3.--Plastics Marine Debris Education Kit developed by The Society of the Plastics Industry, Inc., was mailed to some 1,500 of its member companies.

- Posters (in two sizes) for placement on bulletin boards or in well-traveled areas of the plant.
- Stickers for placement on trash cans and other appropriate waste disposal containers.
- A feature article about marine debris and resin pellets for use in company magazines or newsletters.
- Brochures with additional information for distribution to employees.
- Order form to secure additional quantities of any of the printed materials.

The SPI has filled many orders for kits and individual parts of the kit, both from SPI members and nonmembers, many of whom were alerted to the availability through the public service ad. In addition, kits were distributed via other means, such as SPI resin producer member companies to their customers in the processing business.

The information kit also has been distributed to the plastics industry on the international scene. In the summer of 1988, SPI's Thomas presented copies of the kit to attendees at a meeting of the International Plastics Associations Directors (IPAD) held in Berlin, West Germany. The IPAD periodically brings together the chief executive officers of the 50 worldwide plastics associations to exchange information.

THE SOCIETY OF THE PLASTICS INDUSTRY--PLASTICS WORLD ROUNDTABLE

Representing the plastics industry on the marine debris roundtable spearheaded by NOAA's James Coe, SPI gained a greater understanding of many aspects of marine debris--and saw that the solution must be multifaceted. The many hours of discussion convinced SPI's director of technical and regulatory affairs, H. Patrick Toner, that there must be a role for the SPI beyond what it already was doing.

The plastics industry is noted for its entrepreneurial, turn-a-problem-into-an-opportunity approach to business. The question was how to spark that creative problem-solving for the benefit of the marine environment. As a trade association, SPI does not actually develop specific products. That didn't mean, however, that it couldn't facilitate the process with information.

Working with Plastics World magazine, SPI sponsored in July 1988 a roundtable discussion on the marine debris problem, bringing together representatives from major industries and organizations with a stake in the situation. Participants included:

James Coe, U.S. National Marine Fisheries Service
Joe Cox, American Institute of Merchant Shipping
William Gordon, New Jersey Marine Sciences Consortium
Carl Kirkland, Plastics World
Ralph Rayburn, Texas Shrimpers Association
Thomas S. Scarano, U.S. Navy
Gary Schmidt, American President Lines
Mark D. Sickles, American Association of Port Authorities
Doug Smock, Plastics World
H. Patrick Toner, The Society of the Plastics Industry, Inc.

The result was a five-page story by Smock in the September 1988 issue of Plastics World entitled "Are shipboard plastics all washed up?" Smock (1988) examined the scope of the problem and what options were under consideration, and noted: "Many of the changes being considered will create commercial opportunities for alert entrepreneurs. There are visions of recycling industries sprouting at harbors. And who will manufacture the on-board compactors, incinerators and waste processing equipment being contemplated for marine plastics?"

Clearly, the message had been delivered to the industry. Now, only time will reveal the degree of success.

THE SOCIETY OF THE PLASTICS INDUSTRY SYMPOSIUM ON DEGRADABLE PLASTICS

Since marine debris first began showing up in headlines and on the evening news, the notion of degradable plastics often has been posed as a solution. In late 1986 and early 1987, increased references to this prompted SPI to plan a symposium on the subject. As the "voice of the plastics industry," SPI was being called upon to respond to the viability of the idea, but there was not a ready compendium of current information.

The Symposium on Degradable Plastics, held 10 June 1987 in Washington, D.C., helped solve that problem. Ten presentations on the technology of biodegradable and photodegradable plastics, plus additional papers, resulted in a proceedings book that contained the best available public information on the subject at that time.

In his opening remarks to the overflow crowd of nearly 400, C.E. O'Connell, then president of SPI, said:

> "I hope that by the end of the day we will have enough information to go away thinking about plastics, and particularly plastics packaging, in a new way. We are being asked to think about product design from the cradle to the grave, and as a responsible industry, we must give serious thought to the ultimate disposal of our products after their useful life is finished.
>
> "I doubt that we will come away with many answers today, but as far as I am concerned, that is not really our goal. If we can come away with an appreciation for the difficult questions, and an awareness of the perceived needs, we will be that much closer to determining just where degradability is truly feasible, both today and in the future."

Perhaps Michael Bean of the Environmental Defense Fund, one of the symposium speakers, summed it up best when he told the audience that day:

> "The important environmental questions that must be asked are whether the products of degradation are themselves environmentally safe and whether degradation can occur rapidly enough to reduce significantly the hazards of plastics in the environment. The obvious marketing question is whether plastic products made to degrade can continue to serve their intended function in the marketplace."

Some of the questions posed then still deserve consideration today, but much has happened since that symposium in 1987. Many legislative proposals have been made. Some laws have been passed. A number of companies now offer degradable plastics products.

CONCLUSION

Just as the cause(s) of the marine debris problem is largely an accumulation of careless actions over many years, so too will the solution come in the form of years of dedicated efforts on a variety of fronts. The industry is committed to being a meaningful part of that solution--through both cooperative educational efforts and the development of environmentally safe products.

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MARPOL 73/78 INFORMATION, EDUCATION, AND TRAINING: MEETING THE CHALLENGE

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ABSTRACT

In response to growing public concern about the widespread distributions of marine litter, The Tidy Britain Group, the United Kingdom's agency responsible for the prevention and control of mishandled waste, established a Marine Litter Research Program in 1973. The program's overall strategy has been to quantify the nature and scope of the problem in the coastal and oceanic waters of Western Europe, and to persuade governments, intergovernmental organizations, and the shipping industry of the need for remedial actions.

To date a series of information surveys, public awareness campaigns, and educational initiatives has been completed, including a contribution toward an International Maritime Organization (IMO) training package for ships' crews.

This paper provides an insight into these activities, focusing primarily upon the data collection methods developed for the surveillance of marine litter by beach surveys, the approaches adopted in the public awareness campaigns and educational initiatives, and the observed impacts upon coastal environments. These activities have provided background expertise and knowledge to support the information, education, and training recommendations contained in the IMO Guidelines for the Implementation of Annex V of MARPOL 73/78.

An immediate objective of the information surveys was the development of standardized field survey techniques and analytical methods for the surveillance of marine litter. This has been accomplished by the use of appropriate sampling techniques and the establishment of technical support networks. Consequently, major trends in the composition, origins, distributions, and lifetimes of litter in the marine environment have been identified in a series of baseline surveys. Other studies have identified the safety hazards arising from packaged dangerous goods, clinical wastes, munitions, and pyrotechnics washed ashore.

In R. S. Shomura and M. L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, 2-7 April 1989, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFSC-154. 1990.

Two national shoreline surveys have been completed since 1979, with observations at 4,000 sites around the coastline. Studies of marine litter have been undertaken at all levels within the formal education system, and beach cleanups are frequently undertaken by environmental land amenity groups.

A more recent development is the Blue Flag Campaign in European Economic Community member states. Beaches which receive these awards are expected to be litter free, and ports or marinas are required to provide facilities for the disposal ashore of garbage from ships and pleasure craft.

INTRODUCTION

The Tidy Britain Group is the United Kingdom's national litter abatement organization, with a broad membership including national and local government, industry, commerce, and voluntary organizations. It functions primarily as an advisory body, making available a range of practical programs which it has developed through research, evaluation, and experience over the years.

The group's broad strategy is to deal with the litter problem by tackling the two main root causes: first, the attitudes and behavior of all people towards littering and the environment generally; and secondly, the incorrect handling of rubbish and waste. This has been achieved by a series of ongoing educational and action programs which involve, and target, the entire community.

The Marine Litter Research Program is an integral part of this structure and approach towards litter abatement. It was established in 1973 with an honorary director supported by specialist advisers in educational institutions, industry, commerce, conservation, and amenity groups.

This paper examines the various activities undertaken by the program during the last 16 years, activities that have made a contribution of background knowledge and expertise to the International Maritime Organization's (IMO's) information, education, and training programs for the successful implementation of Annex V of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the 1978 Protocol (MARPOL 73/78) (IMO 1988).

INFORMATION

Program Strategy

Against a 1973 baseline, the strategy of the Marine Litter Research Program was to provide systematic data showing qualitatively and quantitatively the nature and scope of the problem, thereby providing a framework for subsequent remedial actions. To achieve this strategy, and in the absence of any comparative studies, priority was given to meeting basic information requirements. In particular, the program needed to produce data

of sufficient accuracy, drawn from a large enough geographical area, to alert national authorities and intergovernmental organizations to the consequences of uncontrolled discharges of ships' garbage at sea.

The immediate objectives were to:

- Develop standardized field survey techniques and analytical methods for the surveillance of marine litter, and
- Identify the major trends in the composition, distribution, and origin of litter occurring in the coastal and oceanic waters of Western Europe.

Use of Beach Surveys

The relative merits of the different approaches used in assessments of marine litter have been discussed (Dixon and Dixon 1981). Beach surveys supported by adequate site selection sampling methods were selected in preference to observations of litter distributions at sea or estimates of discharges from ships for two reasons:

1. Temporal and spatial sampling constraints are more easily overcome, hence representative areas of shoreline can be surveyed more effectively and accurately than sections of water masses, under most weather conditions.
2. Litter tends to accumulate in the short term on beaches and therefore statistically representative samples can be collected at any given time, avoiding uncertain extrapolations from small sample sizes.

A common component of West European beach litter is containers of all types including bottles, cartons, drums, and cans fabricated from glass, metal, paperboard, plastics, and wood. To discover their characteristics, including geographical origins, contents, and dates of production, samples of the most frequently occurring types and brands were collected and their details recorded. Technical support networks were established with packaging and product manufacturers, especially plastics bottle makers, worldwide. The required information was made available from manufacturers' records of container dimensions and designs and the interpretation of article number codes, manufacturers' imprints, individual date codes, and other overprinted or embossed markings.

Consequently, a data base has been compiled for several hundred different containers on the basis of the following selection criteria:

- They had been marketed continuously for more than 10 years in disposable or one-journey packaging, with documented histories of changes in designs or markings.
- The selected brands were market leaders, and therefore produced in large quantities each year, often in several different countries, with distinctive packages.

- The specimen types constituted a representative sample of all containers observed on beaches, by fabrication materials and contents.

Information gathered from shoreline transects has included total weights of all litter collections and each of the main fabrication materials, and the presence or absence of noncontainer items including plastics fragments, fishing gear, plastics sheeting, clothing, rope, and strapping.

Assessment of Major Trends in Surface Marine Litter

Analysis of the combined data has enabled an assessment of major trends in the composition, distributions, geographical origins, and persistence of litter in the surface waters of Western Europe. Findings show:

- Widespread distributions in both coastal and oceanic waters.
- The prominence of plastics materials, especially polyethylene bottles, polythene sheeting, and fragments of expanded polystyrene.
- The identification of the most frequently occurring containers, by fabrication materials and original contents, including polyethylene lavatory cleanser and household cleaner bottles, glass wine and spirits bottles, metal cans and drums originally filled with beverages and petroleum derived products, and wooden fish boxes.
- A global distribution of countries in which containers are manufactured or marketed, with up to 30% from non-European Economic Community (EEC) member states, including Australia, Brazil, Canada, China, Japan, New Zealand, South Africa, the United States, U.S.S.R., and Venezuela.
- The presence of dangerous items of litter, including fragments of broken glass, sharp pieces of metal, nails protruding from timber, pharmaceutical drugs, syringes and other clinical wastes, civilian and military pyrotechnics, munitions, and packaged dangerous goods.
- The absence of any field evidence to show an accumulation of plastics containers in the marine environment. Relative dating methods have indicated that less than 15% of samples have been obsolete types, and absolute dating from individual date codes has shown that between 86 and 94% of container samples have been <4 years old (Dixon and Dixon 1983).

On the basis of these findings and those from more recent studies, discharges of garbage from ships and other craft have been shown to be the major source of litter found on West European beaches (Chaussepeied 1985;

Vauk and Schrey 1987). The contribution from land-based sources is believed to be relatively small, in the region of 30% of the total, and the result of discards from beach users during the summer holiday season.

Baseline surveys at 185 sample sites around the coastline of the United Kingdom were completed between 1979 and 1987. These will be repeated at the same sites during the next 5 years, and the data will be analyzed on a "before" and "after" basis to evaluate the effectiveness of the Annex V regulations. Supplementary studies will also be undertaken during the same time period to examine the efficiency of port reception facilities for ships' garbage.

Other Findings

Questionnaire surveys and desk studies in cooperation with local authorities and government departments, including the Ministry of Defense, have generated more detailed information on the environmental impacts of marine litter.

For example, local authority beach cleaning operations have usually been confined to the summer holiday period, but recently they have been undertaken throughout the year in many locations to remove increasing quantities of litter washed ashore. The costs incurred are met by the local community and have not been recovered in accordance with the "polluter pays" principle.

Local authorities are also responsible for removing and safely disposing of dangerous substances or items recovered on beaches, especially packages of dangerous goods lost from ships' deck cargoes at sea. At least 100 adults and children have undergone precautionary medical examinations or hospital treatment following exposure to the contents of chemical packages washed ashore in southern England between 1976 and 1986 (Dixon and Dixon 1986).

The shipping industry has reported the loss of productive time as well as repair and replacement costs following damage to ships and pleasure craft from surface floating or semisubmerged items of litter.

Munitions are also widely distributed throughout the coastal waters of the United Kingdom following accidental losses or deliberate dumping in the past. Substantial quantities have been discovered by the general public on beaches, and occasional injuries or fatalities have resulted from the improper handling of a small proportion in dangerous condition (Dixon and Dixon 1979).

Marine Litter Research Program Contributions

The Marine Litter Research Program results and subsequent recommendations have made a contribution to debates and discussions on the subject by national authorities and intergovernmental organizations, thereby achieving the program strategy identified above.

For example, the United Kingdom's Royal Commission on Environmental Pollution supported The Tidy Britain Group's recommendations concerning the need for the government to ratify Annexes III and V of MARPOL 73/78 and provide adequate means for the disposal of shipboard-generated garbage ashore (Royal Commission on Environmental Pollution 1984, 1985).

Similarly, The Tidy Britain Group's recommendation concerning the need to designate the North Sea as a special area for the purpose of Annex V was one of the proposals considered at the Second International Conference on the Protection of the North Sea in November 1987. On behalf of all North Sea states, the United Kingdom has since submitted a proposal with the necessary background information and justification for declaring the North Sea a special area at the Twenty-Sixth Session of the IMO's Marine Environment Protection Convention (MEPC) in 1988. The MEPC subsequently approved amendments to Annex V of MARPOL 73/78 in this regard, and it is envisaged they will be formally adopted by the MEPC at its twenty-eighth session.

Recommendations concerning improvements in the extent and durability of markings and labels on packages containing dangerous and polluting substances, and the efficiency of reporting losses of packaged goods overboard were submitted by the Advisory MEPC on Pollution of the Sea to the MEPC in 1985 and 1986 (IMO 1985, 1986).

EDUCATION

The importance of public awareness campaigns and general educational programs in the protection of the marine environment have long been recognized. In the United Kingdom, attitude surveys have consistently suggested that beach pollution and litter are major areas of public concern (National Opinion Poll 1987). Consequently, considerable effort has been invested by The Tidy Britain Group in the development of suitable resources and materials to focus public attention on the marine litter problem.

At the planning stage a series of informal meetings were held with interested parties including educationists, environmentalists, and potential sponsors in order to identify their requirements and enlist support for the public awareness and general education programs. Considerable experience was made available by The Tidy Britain Group's Schools Research Project Team, which specializes in finding ways of increasing environmental awareness and responsibility in children, with particular reference to the awareness of litter.

At these meetings, formal educationists stressed the need for environmental education programs to meet requirements of existing curriculums, especially the promotion of field studies incorporating a variety of different study skills and learning activities across the educational spectrum. Nonformal educationists pressed for detailed information and practical action, as did environmental groups who, in addition, preferred activities which could attract the media. Potential sponsors set forth numerous requirements, often conflicting with each other. Basically, however, they were all prepared to support environmentally worthwhile projects which were structured with clearly defined objectives.

COMMUNITY PARTICIPATION

Public Awareness Activities

A variety of public awareness campaigns and activities have been completed. Some have been directed specifically at professional and nonprofessional seafarers, and port and terminal operators. For example, the owners of pleasure craft were asked to "Stash their trash ashore" in a poster featuring Dame Naomi James, the first lone round-the-world yachtswoman. In another approach, a soft drinks manufacturer sponsored a comic beachcomber competition in which children were asked to record different plastic bottle makers' imprints, and were awarded prizes for their efforts. Beach cleaning competitions organized by local authorities have also been successful, together with more conventional beach cleanups by members of conservation and amenity groups. Among the numerous events and supporting materials is a poster based on a photograph by Linda McCartney, entitled "Please leave nothing but footprints in the sand."

National Shoreline Litter Surveys

The Sunday Times sponsored the First National Shoreline Litter and Refuse Survey, which ran from June 1978 to October 1979. It was questionnaire-based, and participants were asked to record details of litter, especially container markings and codes, from transects between the water's edge and the backshore zone of beaches. Details from 20,000 containers and the presence or absence of other types of litter were recorded at 797 sites around the coastline. The survey report with a foreword written by Marcus Fox, a parliamentary under secretary of state for the environment, generated considerable media interest nationally and therefore attracted the attention of other government departments and shipping interests (Dixon and Hawksley 1980). It was later submitted to the IMO's MEPC by the Department of Transport as an information paper. Some sewage disposal-related issues were included in the report after one participant explained how she had inadvertently flushed a toilet roll holder down the lavatory and recovered it again 2 days later during a local beach survey.

A Second National Shoreline Survey was launched in 1980, sponsored by the Sunday Times and Sealink UK, a major ferry operator, with the added support of network television time. It was again questionnaire-based but the procedures were improved, giving more detailed information on how to identify litter. Observations were undertaken at more than 3,000 sites around the coastline. Among the unexpected discoveries was a sequence of reports from different localities of foreign items of litter, which appeared to have monitored the passage of an East European fishing fleet. Snowmobile bottles were found elsewhere, and these were traced to the discards of Canadian Eskimos near the polar ice cap.

Both shoreline surveys achieved their objectives, including the provision of detailed information on container markings, which in turn has supported the more specialized research. Compared with similar promotions undertaken by The Tidy Britain Group, the shoreline surveys generated considerably more media interest locally and nationally, and were also highly cost-effective. In many instances, educational institutions from

primary schools to universities have adopted the surveys, with suggested learning activities, on a long-term basis.

The Blue Flag Campaign

A major public relations operation in favor of the marine environment is the Blue Flag Campaign, launched during the European Year of the Environment by the Foundation for Environment Education in Europe. The campaign has the financial support and patronage of the Commission of the European Communities. The main objective is to raise awareness about the quality of the marine environment and the need to protect it. During 1988, a total of 373 beaches and 102 ports and marinas in 10 EEC member states were awarded blue flags for the high standards of environmental quality, the provision of services, and the promotion of environmental education (Foundation for Environment Education in Europe 1988). Blue Flag beaches are required to be free from litter, and ports or marinas which qualify are expected to provide facilities for the disposal of garbage ashore from ships and pleasure craft. There is also a Blue Flag charter for boat owners, which is based upon a voluntary code of conduct.

In the United Kingdom, beaches that are unable to qualify for blue flags on the basis of inadequate bathing water quality, are encouraged to enter for Clean Beach awards, a scheme funded by the Department of the Environment.

TRAINING

Throughout its history, the IMO has attached the utmost importance to the training of ships' personnel to help achieve its most important objectives, namely, improvements in maritime safety, and the prevention and control of marine pollution from ships.

Given the rapid changes and developments in world maritime trade and shipping operations, there is an even greater emphasis on the part of the IMO to ensure that the various conventions, codes, and other instruments already adopted are effectively enforced and implemented.

Therefore, in the context of the implementation of Annex V of MARPOL 73/78, considerable effort has been directed towards the preparation of comprehensive and practical guidelines with the following objectives:

- To assist governments in developing and enacting domestic laws which give force to and implement Annex V.
- To assist vessel operators in complying with the requirements set forth in Annex V and domestic laws.
- To assist port and terminal operators in assessing the need for, and providing, adequate reception facilities for garbage generated on different types of ships.

Section 2 of the guidelines recognizes the importance of information, education, and training programs in the implementation process. Given the

need for commercial vessels and other craft to change garbage disposal practices which have persisted for many generations, it is generally believed that comprehensive training packages have an important role in assuring the success of Annex V.

Consequently, with funding provided by the United Kingdom Government and the IMO/Swedish International Development Authority Program for the Protection of the Marine Environment, a training package on marine litter has been prepared for worldwide distribution. Data and other expertise held by The Tidy Britain Group were extensively drawn upon in the production of this material.

The principal aims of the training package are first, to change attitudes and create an awareness of the need to prevent damage to the marine environment from the improper disposal of ships' garbage at sea, and secondly, to provide the necessary background knowledge and identify the practical means of doing so.

The target audience includes not only seafarers and port or terminal operators, but trade associations, shipbuilders, packaging manufacturers, waste management industries, coastal communities, educators, and governments.

With background resource materials contributed by interested parties worldwide, including conservation groups, governments, and the private sector, the training package provides a general overview of the marine litter problem focusing upon:

- the sources and types of garbage generated by ships;
- the environmental impacts of marine litter on wildlife and coastal amenities;
- shipboard garbage handling and storage procedures;
- equipment available for port reception facilities; and
- the Annex V regulations and their implications.

Despite the enormity of the task to be achieved in the successful implementation of Annex V, evidence of new initiatives and innovations has already come to light. Manually operated garbage compactors are now included in the design and construction of some yachts and other pleasure craft in Scandinavian countries, and in some coastal communities of the United States unwanted fishing gear is recycled for decorative purposes instead of being discarded at sea.

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EDUCATION AND AWARENESS: KEYS TO SOLVING THE MARINE DEBRIS PROBLEM

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ABSTRACT

The Center for Marine Conservation (CMC)--formerly known as the Center for Environmental Education--is a nonprofit conservation organization. The CMC currently conducts a national education campaign on the problems caused by plastic debris in the marine environment. The campaign includes the development and distribution of educational materials to the commercial fishing, merchant shipping, and plastics industries as well as to recreational fishermen, pleasure boaters, and the general public. This program is sponsored in part by the U.S. National Oceanic and Atmospheric Administration's (NOAA), Marine Entanglement Research Program and The Society of the Plastics Industry. Also, under contract to NOAA, CMC distributes information through its National Marine Debris Information Office. The CMC also administers the National Marine Debris Data Base. With support from NOAA, the U.S. Coast Guard, and the U.S. Environmental Protection Agency, the CMC distributed 43,000 data cards to volunteers in all 25 coastal states. Information obtained from volunteer data collection efforts will become part of CMC's national analysis of marine debris data.

INTRODUCTION

There is virtually unanimous agreement that education is necessary to motivate groups and individuals to dispose properly of wastes, especially plastic waste. Several international conferences have stressed the need for marine debris education programs, including the 1984 International Workshop on the Fate and Impact of Marine Debris, the North Pacific Rim Fishermen's Conference on Marine Debris, and the Oceans of Plastic Fishermen's Workshop. Federal legislation entitled the Marine Plastic Pollution Research and Control Act of 1987 mandates that the U.S. National Oceanic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency (EPA) conduct a 3-year public education program. The 1989 Interagency Task Force on Marine Debris encourages marine debris education: "Concerned federal agencies should work with each other, state

In R. S. Shomura and M. L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, 2-7 April 1989, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFSC-154. 1990.

and local governments, private industry, and environmental groups to develop comprehensive educational materials on problems caused by marine debris and on ways to solve those problems" (Interagency Task Force on Persistent Marine Debris 1988).

The Center for Marine Conservation (CMC)--formerly the Center for Environmental Education (CEE)--knows that education will be the most effective method to alter 4,000 years of ocean disposal behavior. When mariners realize and understand the effects that their age-old habits have on wildlife and human and vessel safety, they are willing to make a change. Since 1985, the CMC has developed an education campaign that encourages all members of industry, the general public, and the maritime community to get involved. It publishes documents, organizes beach cleanups, and responds to requests for information that encourages groups and individuals to take part in the solution to ocean pollution.

GETTING THE MESSAGE OUT

Early Efforts at Education

Prior to 1984 there were only a handful of programs working to teach people about the problem of marine debris. Judie Neilson's "Get the Drift and Bag It" campaign was not only the first marine debris education program, but also a highly successful coastal cleanup in Oregon (Neilson 1985). Also in 1984, the Workshop on the Fate and Impact of Marine Debris produced several recommendations discussing the need for marine debris education programs (Shomura and Yoshida 1985). The concept of marine debris education was so new that in the workshop proceedings these education recommendations were hidden under the general category of "Report of the Working Group on Management Needs." The subcategory entitled "Public information and education" recommended:

> "Recognizing that greater benefits are likely to be realized as a result of positive rather than negative incentives, (Working) Group participants urged that significant emphasis be placed upon public information and education and that steps specifically be taken to:
>
> "a. Work with fisheries organizations and the fishery management councils to develop and carry out comprehensive information and education programs for foreign fishermen, working within the exclusive economic zone, and U.S. fishermen;
>
> "b. Work with appropriate national and international organizations to undertake cooperative comprehensive information and education programs; and
>
> "c. Work with relevant industries, such as has been done with elements of the plastics industry, on public education programs."

The subcategory entitled "Debris cleanup" recommended:

> ". . .immediate steps to remove existing debris from the environment are clearly needed and concentrated efforts should be directed to reducing the rate at which new debris is deposited. The management steps recommended are:
>
> "a. To undertake cleanup programs to remove existing debris from shore areas and the water column;
>
> "b. To assign priority to areas where the density of debris is such that it affects endangered, threatened, or commercially valuable species;
>
> "c. To require that all potentially harmful debris be retained onboard vessels until proper disposal is possible;
>
> "d. To encourage the removal of debris from the environment and prevent the discarding of additional debris, positive incentives such as financial rewards for the return of discarded netting material should be considered as should possible negative incentives; and
>
> "e. To take such actions as may be necessary to assure the proper disposal of unwanted materials in a nonharmful manner."

These recommendations identified a need for marine debris education and provided the baseline for all future education programs.

Plastics Debris Problem

In 1986, the EPA commissioned CMC to prepare a report on the plastics debris problem in the marine and Great Lakes waters of the United States. As the first comprehensive review of available information on marine debris, this document showed that plastics debris is a nationwide problem for marine wildlife. The report identified the major ocean- and land-based sources of plastics debris, and indicated that the total amount of debris generated by these sources is unknown. The report noted the absence of appropriate laws to address the plastic debris problem (CEE 1987a). Finally, the study helped to redirect attention from general marine debris to those problems caused specifically by plastic items.

Upon completion of the document, CMC presented the report to members of The Society of the Plastics Industry (SPI), explaining that plastics debris was threatening wildlife and vessel safety in addition to being unsightly. The plastics industry accepted CMC's invitation to become part of the solution. The result has been the development of numerous brochures, books, and posters geared to promoting proper disposal of plastics at sea.

PUBLIC AWARENESS AND RESPONSE

Beach Cleanups

The CMC's most successful efforts have been its citizen beach cleanups in Texas and Florida. From 1986 to 1988, it organized the largest beach cleanups in American history, accounting for one-third of the nation's total participation. Diverse groups worked toward a common goal: industry provided financial and in-kind support; government and environmental organizations acted as regional coordinators; and the general public together with all these groups removed trash from the beaches.

Since 1984 there has been a steady growth in beach cleanup participation (Fig. 1). In 1984, Judie Neilson encouraged 2,100 Oregonians to clean the beaches. Nationwide during Coastweeks '88, more than 47,000 people participated in coastal cleanups. In 1989, we expect the participation to increase to 60,000, and our goal is to work with the states to encourage 100,000 citizens to clean the beaches by Coastweeks '92.

A beach cleanup is not just a 1-day event, but rather an ongoing education campaign. The CMC's volunteer data collection system is one mechanism that ensures continuing education. Beach cleanup data help identify possible sources and quantify the amounts of debris found by volunteers. Each cleanup volunteer receives a data card and a "Guide to Good Data Collection." The data card lists items volunteers will likely collect during a beach cleanup. The guide explains the importance of data collection and describes items that are found on most beaches yet are difficult to identify.

In Texas and Florida, volunteers work in pairs to share the tasks of debris collection and data recording. From volunteer data, the CMC published two reports on the Texas debris problem (CEE 1987b, 1988b). These reports document the sources of debris and include recommendations to reduce the marine debris problem. In some cases it is possible to attribute certain types of beach debris to a specific source. For example, volunteers found 4,170 plastic light sticks on Texas beaches in 1987. Fishermen commonly use light sticks to attract fish to their hooks. Although it is counterproductive to point accusatory fingers, CMC uses indicative data to encourage possible debris contributors to become active contributors to the solution.

Press generated from a cleanup also helps maintain the long-term education effects. Media coverage reaches people who may not donate their Saturday mornings to clean the beach, but may unconsciously discard their boat or beach trash. The CMC uses the media to remind the public that their plastic trash can have disastrous effects on marine wildlife. The 1986 Texas Coastal Cleanup campaign not only increased awareness among the general public, but also helped the Texas General Land Office initiate a statewide "Adopt-A-Beach" program.

Figure 1.--Volunteer participation during beach cleanups from 1984 to 1990.

National Marine Debris Data Base

In 1988, the CMC expanded its Texas data collection efforts to establish a National Marine Debris Data Base. With support from the EPA, NOAA, and the U.S. Coast Guard, CMC distributed 43,000 data cards to cleanup volunteers in all 25 coastal states. In addition, Spanish data cards were sent to cleanups in Puerto Rico, Costa Rica, and the Dominican Republic. The resulting data base is providing essential information for understanding specific debris problems in each part of the country. O'Hara's paper entitled "National Marine Debris Data Base" gives a detailed analysis of the preliminary results from the first nationwide assessment of coastal debris (O'Hara 1990). The CMC's final report will be out in June 1989.

The CMC's data base relies on volunteer cooperation, and CMC realizes that it is not the same as a rigorous scientific survey. Nonetheless, their data give consistent perspectives of the problem and indicate some

common trends. For example, in all states plastics account for between 55 and 65% of all debris types collected. In 1988, the fact that Florida volunteers collected 489.1 km (304 mi) of monofilament fishing line indicates a large (although not exclusive) contribution from the recreational fishing community. The data from Florida were used by Governor Bob Martinez and his staff to prepare an executive order to provide state enforcement of MARPOL Annex V and to research the use of degradable fishing line. Finally, data collected in 1988, prior to implementation of Annex V, will provide a baseline of information to measure loosely the effectiveness of international and national legislation to reduce ocean pollution.

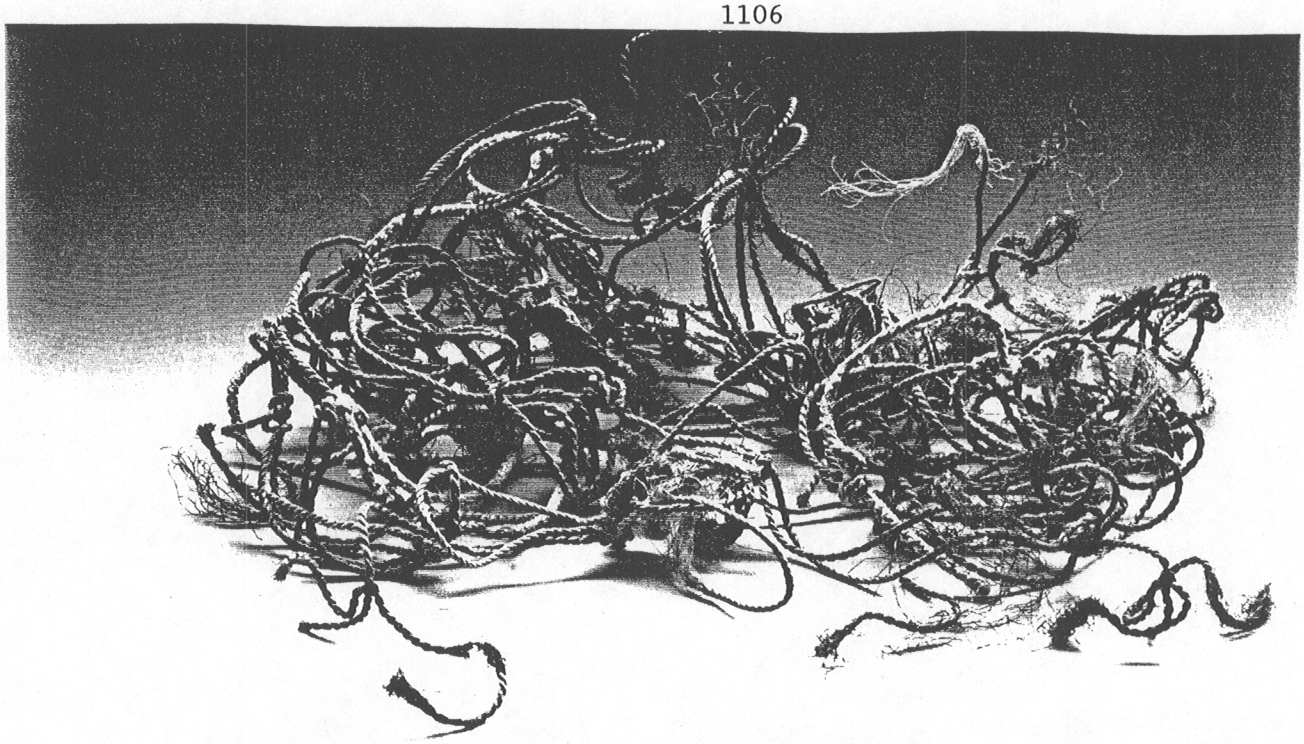
Marine Debris Information Offices

Under contract to NOAA, CMC coordinates two marine debris information offices (MDIO). The first is in Washington, D.C., to serve the Atlantic coast and Gulf of Mexico. The second, in San Francisco, responds to Pacific coast inquiries. The CMC and NOAA created these offices in response to a growing number of requests for information on the marine debris problem. The MDIO functions to disseminate educational materials and other information on marine debris to government agencies, industry groups, educators, the press, and the general public. In most cases, requests for information fall into specific categories. To respond efficiently to these requests, 16 standardized educational packets were developed :

- General public.
- Teachers and educators.
- Elementary (kindergarten to fifth grade),
- Middle school, high school (6th to 12th grade) and college students.
- Beach cleanup information.
- Recreational fishermen and boaters.
- Press and media personnel.
- Plastics recycling and degradable plastics information.
- Cruise ship passengers.
- Fishermen and fish processors.
- Cargo vessel operators and crews.
- Offshore oil and gas (companies).
- Offshore oil and gas (workers).
- Plastics manufacturers and resin pellet producers.
- Port and terminal operators.
- Charter vessel operators.

All packets contain general information about the marine debris problem, with additional information specific to the requester's interest. From the establishment of the MDIO in October 1988 until 1 April 1989, CMC responded to 842 requests for information. Also available from the MDIO are numerous education materials developed by NOAA, SPI, and CMC as part of a national campaign to promote the proper disposal of plastics.

Chronologically, the first element of the joint educational campaign consisted of print public service advertisements developed for each of the



This discarded net is done fishing. But it's not done killing.

When worn fishing nets or other plastic gear is dumped or lost in the water, something else happens: animals die.

Seabirds get caught in nets when diving for food, and drown. Other marine animals become entangled in them and slowly strangle.

Discarded nets and traps even compete with you, by needlessly catching and killing millions of pounds of potentially valuable fish and shellfish.

In addition, plastic wastes can foul propellers and block cooling intakes, causing costly vessel disablement.

Over 100,000 tons of plastic fishing gear are dumped into our oceans every year. This critical issue is destined to attract increasing public and government scrutiny if we fail to take action to solve it.

So please, alert your dock operators that you'll need trash facilities, because you're saving your plastic trash and worn out gear for proper disposal on land. That's not all you'll be saving.

To learn how you can help, write: Center for Environmental Education, 1725 DeSales Street, N.W., Suite 500, Washington, D.C. 20036.

A public service message from:
The Center for Environmental Education
The National Oceanic and Atmospheric Administration
The Society of the Plastics Industry

Figure 2.--Commercial fishing public service advertisement.

following groups: commercial fisheries (Fig. 2), merchant shippers (Fig. 3), the plastics industry (Fig. 4), recreational boaters (Fig. 5), and recreational fishermen (Fig. 6). To date these ads have appeared in 30 magazines and major trade journals in addition to several regional and local publications including National Fisherman, Marine Log, Modern Plastics, Outdoor Life, and Saltwater Sportsman. Each advertisement directs interested persons to the MDIO for more information about marine debris. The MDIO in turn responds to each request by sending the appropriate information packet and relevant materials.

Each public service advertisement has a corresponding eight-panel brochure with more information on how marine debris affects that particular group. For example, commercial fishermen may be more interested in the fact that discarded gillnets will foul their propellers rather than in the effects the nets may have on seals, which in some cases are viewed as competitors. Groups often request large quantities of brochures for their own distribution. To date, the MDIO has distributed over 60,000 brochures to educators, individuals, and the government, including 15,000 National Safe Boating Week press packets, 8,000 for National Fishing Week, and 3,000 to Coast Guard port captains.

A Citizen's Guide to Plastics in the Ocean: More Than a Litter Problem is another product of the cooperative NOAA, SPI, and CMC campaign that is now available through the MDIO (CEE 1988a). The book informs citizens of the growing problem of plastics in the ocean and gives suggestions on how individuals can become involved in solving this problem. The MDIO has distributed 19,000 copies of this guide since September 1988, including 5,000 copies to the U.S. Navy as part of their educational package on marine debris. Due to the popularity of the book, it is now ready for a second printing that will contain more current information on Annex V and new initiatives to stop plastic pollution at sea.

The MDIO also distributes materials produced by other groups. Recht's (1988) Reference Guide for Ports is a valuable source of information on how ports can comply with the requirements of MARPOL Annex V and the U.S. Marine Plastic Pollution Research and Control Act of 1987. Figure 7 shows the most current version of the MDIO order form with the most frequently requested educational materials.

The CMC staff believe that each person requesting information is a potential grassroots organizer able to educate others about the problems of plastic debris. The staff cultivates each request and acts to network people and information. The elementary school information packet uses a "Playa Pen Pal" program to network even the youngest requests ("playa" means beach in Spanish). All children who ask for information receive the names and addresses of the last three children who wrote in, and are encouraged to exchange information about marine debris in their part of the country with their playa pen pal.

When it's done holding your ship's garbage, it could hold death for some marine animals.

This plastic trash bag may not look like a jellyfish to you. But to a hungry sea turtle, it might. And when the turtle swallows an empty bag, the mistake becomes fatal.

The problem is more than bags. Plastic six-pack holders sometimes become lodged around the necks and bills of pelicans and other seabirds, ultimately strangling or starving them. Other plastic refuse, either through ingestion or entanglement, causes the deaths of thousands of seals, whales, dolphins and other marine mammals every year.

Plastic debris also causes costly and potentially hazardous delays to shipping when it fouls propellers or clogs intake ports.

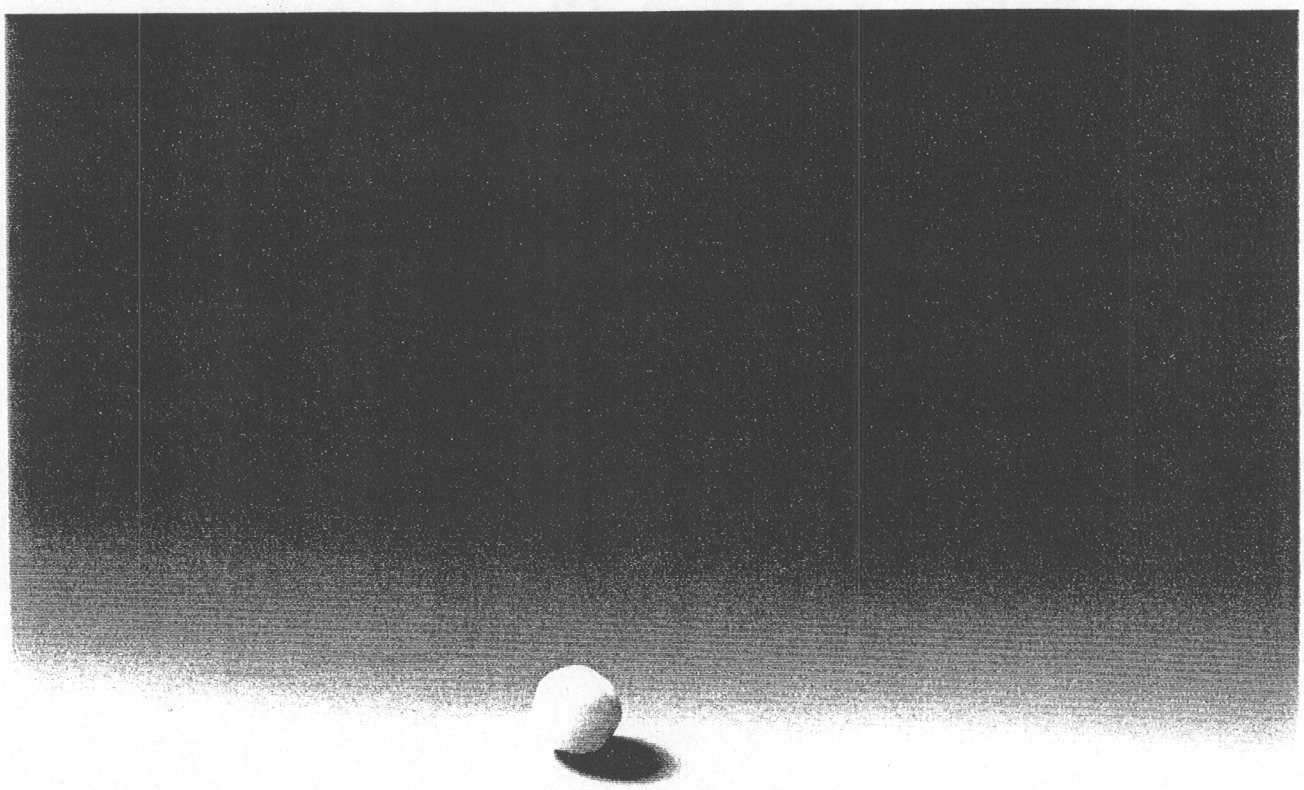
It's a critical issue, destined to attract public and government scrutiny if we fail to take action to solve it.

So please, stow your trash, and alert your shipping terminals that you will need proper disposal on land. A sea turtle may not know any better. But now, you do!

To learn how you can help, write: Center for Environmental Education, 1725 DeSales Street, N.W., Suite 500, Washington, D.C. 20036.

A public service message from:
The Center for Environmental Education
The National Oceanic and Atmospheric Administration
The Society of the Plastics Industry

Figure 3.--Commercial shipping public service advertisement.



A seabird could mistake this resin pellet for a fish egg. And die.

One little pellet may be insignificant to your plastics processing operation. But to thousands of seabirds, it could lead to a fatal error.

These pellets, in many shapes and sizes, can be washed down drains as waste or reject material, or spilled in the course of normal handling. But ultimately, they may find their way to bodies of water, where the real trouble begins.

When eaten in sufficient quantity by a seabird, they can block digestion or sometimes fool the bird into thinking it is not hungry, causing eventual starvation. Fish and sea turtles can suffer the same fate.

The growing problem of plastic trash in our oceans threatens more than wildlife. This critical issue is destined to invite increasing public and government scrutiny unless we take action to solve it.

So please: see that resin pellets are reclaimed or disposed of properly. If we ignore the problem, we—like the unfortunate seabird—will be making a serious mistake.

To learn how you can help, write: The Society of the Plastics Industry, 1275 K Street, N.W., Suite 400, Washington, D.C. 20005.

A public service message from:
The Center for Environmental Education
The National Oceanic and Atmospheric Administration
The Society of the Plastics Industry

Figure 4.--Plastics industry public service advertisement.

This discarded line is done fishing. But it's not done killing.

Carelessly discarded plastic fishing line can keep working long after you're done with it—entangling birds, seals, sea turtles, and other animals.

And because plastic line is strong and durable, it's nearly impossible for these animals to break free. They strangle, drown, or starve. That's not sporting.

Some birds even use old fishing line in their nests, creating death traps for their young.

Other plastic debris can be dangerous, too. Fish, birds, and seals become entangled in six-pack rings. Sea turtles eat plastic bags—which they mistake for jellyfish—and suffer internal injury, intestinal blockage, or death by starvation. Birds are known to ingest everything from small plastic pieces to plastic cigarette lighters and bottle caps.

Plastic debris also can foul boat propellers and block cooling intakes, causing annoying—sometimes dangerous—delays and causing costly repairs.

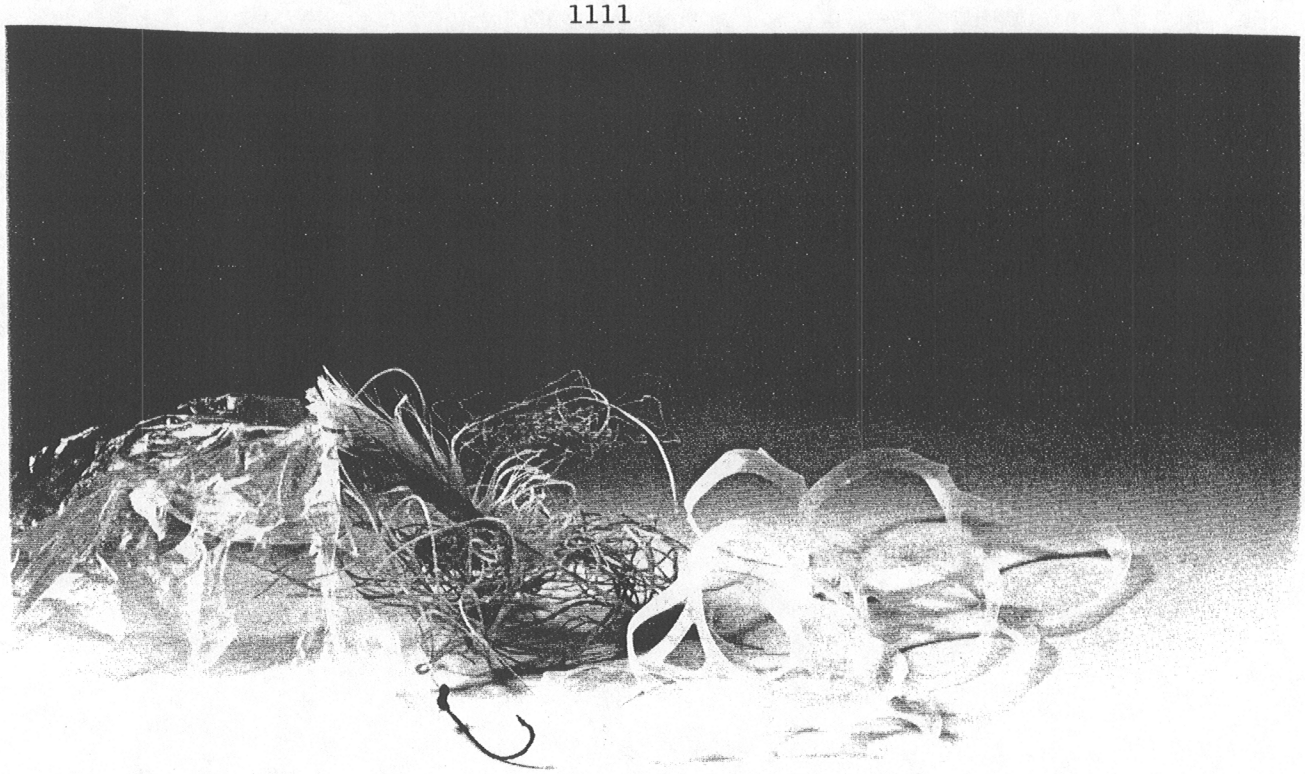
So please, save your old fishing line and other plastic trash for proper disposal.

That's not all you'll be saving.

To learn more about how you can help, write: Center for Environmental Education, 1725 DeSales Street, N.W., Suite 500, Washington, D.C. 20036.

A public service message from:
The Center for Environmental Education
The National Oceanic and Atmospheric Administration
The Society of the Plastics Industry

Figure 5.--Recreational fishing public service advertisement.



Tossing this trash overboard could leave death in your wake.

Throwing a few plastic items off a boat may seem harmless enough. What's one more six-pack ring, plastic bag, or tangled fishing line?

Actually, it's one more way a fish, bird, seal, or other animal could die.

Fish, birds, and seals are known to strangle in carelessly discarded six-pack rings. Sea turtles eat plastic bags – which they mistake for jellyfish – and suffer internal injury, intestinal blockage, or death by starvation.

Other plastic trash can be dangerous, too. Birds are known to ingest everything from small plastic pieces to plastic cigarette lighters and bottle caps.

Birds, seals, sea turtles, and whales die when they become trapped in old fishing line, rope, and nets.

Plastic debris also can foul boat propellers and block cooling intakes, causing annoying – sometimes dangerous – delays and causing costly repairs.

So please, save your trash for proper disposal on land.

That's not all you'll be saving.

To learn more about how you can help, write: Center for Environmental Education, 1725 DeSales Street, N.W., Suite 500, Washington, D.C. 20036.

A public service message from:
The Center for Environmental Education
The National Oceanic and Atmospheric Administration
The Society of the Plastics Industry

Figure 6.--Recreational boating public service advertisement.

NOAA'S MARINE DEBRIS INFORMATION OFFICE

OPERATED BY THE CENTER FOR MARINE CONSERVATION

EDUCATION MATERIALS LIST AND ORDER FORM

Name _____

Organization _____

Address _____

_____ Phone _____

The National Oceanic and Atmospheric Administration's (NOAA) Marine Debris Information Office distributes educational materials about the effects of plastic in the ocean and about MARPOL Annex V. The materials are free to the public unless otherwise stated. **Please order only what you will honestly use because we do have limited quantities.**

INFORMATIONAL PACKETS - Choose 4 types (limit 2 packets each)

We have developed a number of informational packets to meet the needs of different interest groups, however the packets do contain the same basic information.

Qty.

Elementary School Student _____
Middle, High and College Students _____
Teachers or Other Educator _____
General Public _____
Beach Cleanup _____
Plastics Recycling and Degradability _____
Offshore Oil and Gas Industry _____
Recreational Boating/Fishing _____
Commercial Shipping _____
Port and Terminal Operator _____
Press and Media Personnel _____
Plastics Manufacturers/Resin Pellet Producer _____
Cruise Ship Passenger _____
Commercial Shipping _____

BROCHURES - Up to 200 free

These are 8-panel brochures discussing the problems caused by plastic as related to the interest group mentioned in the title.

Recreational Boating - "Tossing this..." _____
Recreational Fishing - "This discarded..." _____
Commercial Shipping - "When it's done..." _____
General Public - "Our Planet is..." _____

PACIFIC COAST OFFICE: 312 Sutter St., Suite 606, San Francisco, CA 94108 (415) 391-6204 FAX (415) 956-7441
ATLANTIC/GULF COAST OFFICE: 1725 DeSales St., NW, Washington, DC 20036 (202) 429-5609 FAX (202) 872-0619

Figure 7.--Current version of NOAA's Marine Debris Information Office order form.

ASSESSING THE IMPACT OF THE CENTER FOR MARINE CONSERVATION'S EDUCATIONAL PROGRAMS

Although empirical evidence shows us that hands-on programs are the best form of education, the CMC's 1989 Saltonstall-Kennedy (SK) grant will demonstrate the actual effects of its education programs. Prior to conducting any education events, CMC distributed surveys to a random sample of commercial and recreational fishermen in four designated test areas: Hampton, Virginia; Martin County, Florida; Bayou La Batre, Alabama; and Taylor County, Florida (as a control group). Wallace (1990) of Kearney-Centaur Associates discusses the results of this first SK survey in the paper entitled: "How Much Do Commercial and Recreational Fishermen Know About Marine Debris and Entanglement? Phase 1."

From March to July 1989, the CMC will conduct concentrated educational activities within three of the test areas, excluding the control area of Taylor County, Florida. It will adapt educational activities to accommodate regional differences, style, and events. For example, a large percentage of Martin County, Florida's, recreational fishing community will participate in or attend Arthur Smith Kingfish, Dolphin, Wahoo Fishing Tournament. In addition to providing educational materials to tournament participants, CMC will involve spectators by conducting "Stow It, Don't Throw It" raffle contests for such prizes as boat coolers and fishing reels.

The CMC will distribute a revised version of the survey upon the conclusion of these educational programs. The second survey developed by Kearney-Centaur Associates will assess the impacts of CMC's educational activities. It believes the survey results will statistically demonstrate increased public awareness.

The CMC makes one primary assumption in its approach to solving the marine debris problem. It believes that education will motivate people to alter any harmful disposal behavior. Enforcement of international and national legislation will be very difficult. Marine debris research is both expensive and difficult to conduct in the ocean environment. The CMC feels that education in the form of publicity, books, and if possible hands-on educational events such as beach cleanups will encourage people to keep harmful trash out of the water.

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SHIPPING INDUSTRY MARINE DEBRIS EDUCATION PLAN

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ABSTRACT

The Shipping Industry Marine Debris Education Plan is an education and awareness program on MARPOL Annex V and its consequences for foreign and domestic commercial shippers and cruise lines operating in U.S. waters and for port and terminal operators. The plan is based on the premise that education may be a key factor in gaining voluntary compliance with MARPOL Annex V provisions and, therefore, in reducing the problems caused by marine debris and entanglement. The plan identifies five core and three ancillary activities to increase the shipping industry's awareness of MARPOL Annex V and the consequences of marine debris and entanglement. It was developed in late 1988 and early 1989 under contract to the Marine Entanglement Research Program, U.S. National Marine Fisheries Service. The recommended activities will be implemented over a 9-month period beginning in the spring of 1989. The core activities are: 1) development of case studies of MARPOL Annex V compliance activities, 2) development of a model plastics refuse control and minimization plan, 3) preparation of a MARPOL Annex V kit--a one-source document on MARPOL Annex V implementation in the United States including crew awareness training on the consequences of marine debris, 4) liaison activities with international shipping industry trade associations, and 5) seminars for cruise line owners/operators. The ancillary activities are: 1) placement of public service advertisements on marine debris in trade journals, 2) placement of posters on MARPOL Annex V and marine debris in port areas and on board vessels, and 3) presentations on the plan and its activities at seminars and workshops.

INTRODUCTION

On 31 December 1988, in response to at-sea garbage disposal limitations that went into effect worldwide, the way mariners handle disposal of ship-generated garbage changed. On that date, Annex V of the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73/78) went into effect. Formally, MARPOL Annex V is entitled,

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In R. S. Shomura and M. L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, 2-7 April 1989, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFSC-154. 1990.

"Regulations for the Prevention of Pollution by Garbage from Ships." Simply, Annex V prohibits at-sea disposal of plastic materials and specifies the distance from shore that all other materials may be dumped.

The MARPOL Annex V will be difficult to enforce. Among other things, it changes the traditional way of handling ship-generated garbage. Education may be a key factor in gaining compliance with MARPOL Annex V. In the last several years, marine debris education programs have been developed and implemented for several major marine industry groups (for example, offshore oil and gas workers and commercial fishermen). The current project focuses on marine debris education for the shipping industry.

The amount of garbage generated by the shipping industry varies. It is estimated that large commercial vessels generate between 18 and 40 garbage bags of plastic during a typical voyage. This includes both domestic wastes and plastics included in dunnage. Tow and tugboats are estimated to generate one to three bags of plastic per voyage. Cruise ships are estimated to generate over 70 bags of plastic per day (Eastern Research Group 1988). Until MARPOL Annex V, much of this garbage was disposed of at sea.

The Shipping Industry Marine Debris Education Plan was developed under contract to the Marine Entanglement Research Program, U.S. National Marine Fisheries Service (NMFS) to: 1) ensure that foreign and domestic commercial shippers and cruise lines operating in U.S. waters, and port and terminal operators are aware of the provisions of MARPOL Annex V as it is being implemented in the United States; and 2) encourage voluntary compliance with those provisions. It was developed to help avoid disruption of shipping schedules, which could occur if U.S. prosecution of at-sea garbage disposal violators is necessary. The plan was also designed to be part of the solution to the problems of marine debris by furthering awareness of its consequences.

METHODOLOGY

The Shipping Industry Marine Debris Education Plan was developed using four concurrent tasks (Fig. 1) involving data collection and review of existing information, a synthesis task, and an industry advisory panel. The concurrent tasks were completed using secondary sources and key informant contacts. The major points which emerged from the tasks helped to structure the recommended plan activities.

An industry advisory panel for the project was created to involve the industries affected by the plan in its development. By doing so, the intent was to avoid identifying marine debris education activities which would not work. It was also a mechanism to encourage industry's further involvement with the plan, its implementation, and the issue of marine debris and entanglement. Four trade associations, the U.S. Department of Agriculture, the U.S. Coast Guard, and a maritime professional association participated on the panel.

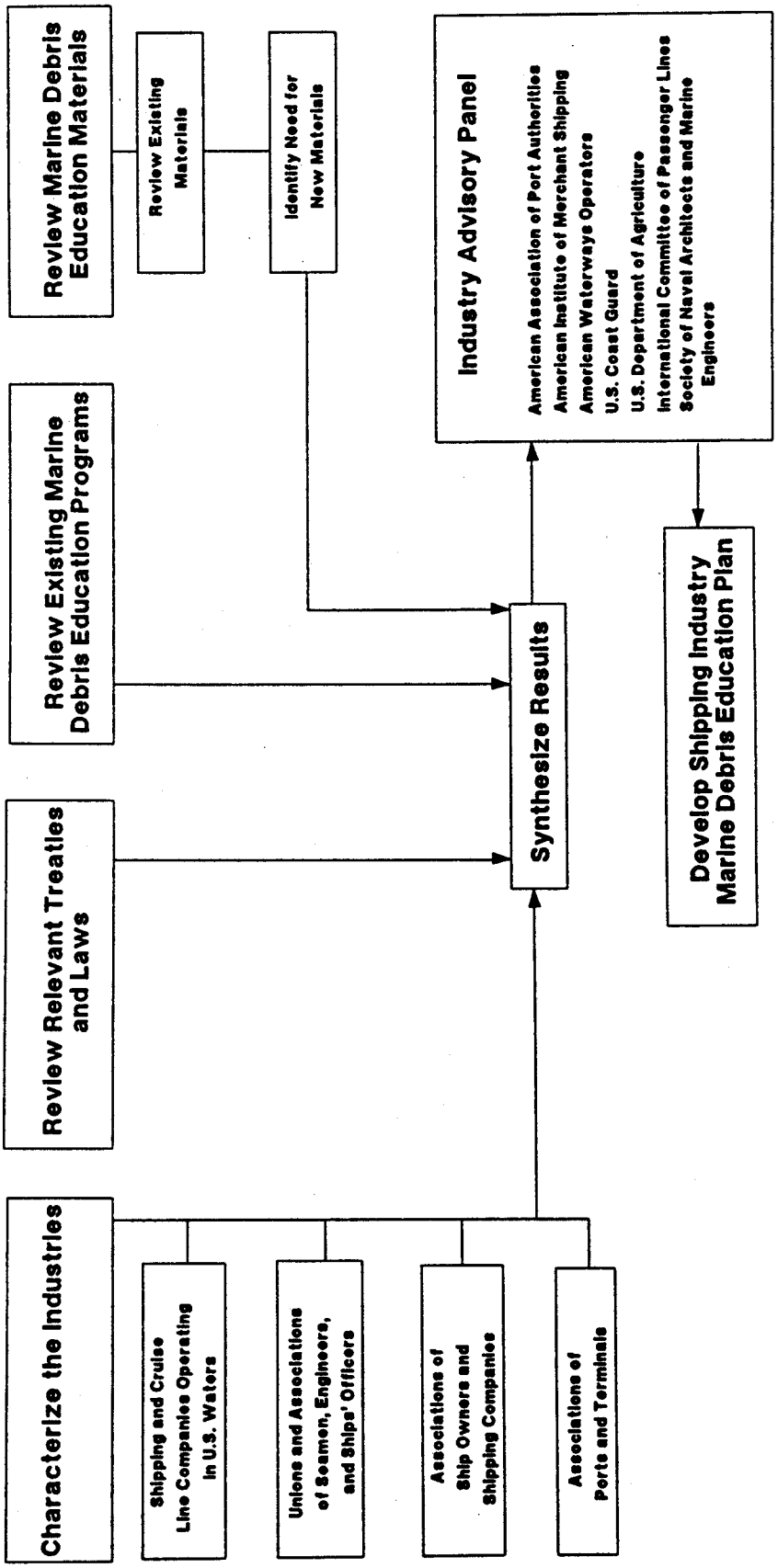

Figure 1.--Plan development methodology.

A preliminary list of marine debris education activities was developed based on the results of the data collection and synthesis tasks. A packet of materials, including a one-page summary of eight marine debris education activities, was sent to each panel member for review. The industry advisory panel attended a 1-day meeting in Alexandria, Virginia, to discuss MARPOL Annex V implementation and the Shipping Industry Marine Debris Education Plan. The marine debris education activities recommended in the plan reflect the input of the industry advisory panel.

RECOMMENDED MARINE DEBRIS EDUCATION ACTIVITIES FOR THE SHIPPING INDUSTRY

Eight marine debris education activities are recommended for the shipping industry. An overview of these activities is presented in Figure 2. Activities 1 through 5 are the core activities in terms of time and budget. Activities 6 through 8 will have a secondary emphasis, but some time and funds will be allocated to them.

Core Activities

Activity 1: Case Studies of MARPOL Annex V Compliance Activities

No one method of compliance with MARPOL Annex V will work for all vessels because of differences in such things as size, routes, cargo, and owners. The case studies will document policies and activities (including crew awareness training) that operators of different types of vessels as well as port and terminal operators are using to comply with MARPOL Annex V. The approaches different companies are using for MARPOL Annex V compliance are expected to reflect these differences. For example, seagoing vessels, which include commercial shippers and cruise lines, must comply with regulations on food waste coming from foreign waters, as set forth by the Department of Agriculture Animal and Plant Health Inspection Service (APHIS), as well as the provisions of MARPOL Annex V. Some of these vessels may also travel to special areas as defined by MARPOL Annex V, where dumping limitations are further restricted. Some coastal waterway vessels travel far enough from shore to be able to dump some types of garbage at sea legally. These vessels do not leave U.S. waters and, therefore, do not need to comply with APHIS regulations or the dumping restrictions in MARPOL Annex V special areas. Vessels in inland waterways and harbor areas have been prohibited from dumping garbage overboard for almost 100 years. Flexibility in the method used is seen by many in the industry as a key to voluntary compliance. The case studies will document how and to what extent flexibility is used for MARPOL Annex V compliance.

Until recently, much effort in marine debris education was spent identifying the sources of debris and convincing those industries or marine user groups that their practices were causing problems. This had a negative tone. The case studies will be examples of positive actions companies have taken to change the way they handle plastics and garbage disposal. They will demonstrate the range of techniques that companies have used to comply with MARPOL Annex V. They will also identify some of the problems encountered and how these were overcome. The case studies will be developed through key contact interviews and documents provided by these contacts.

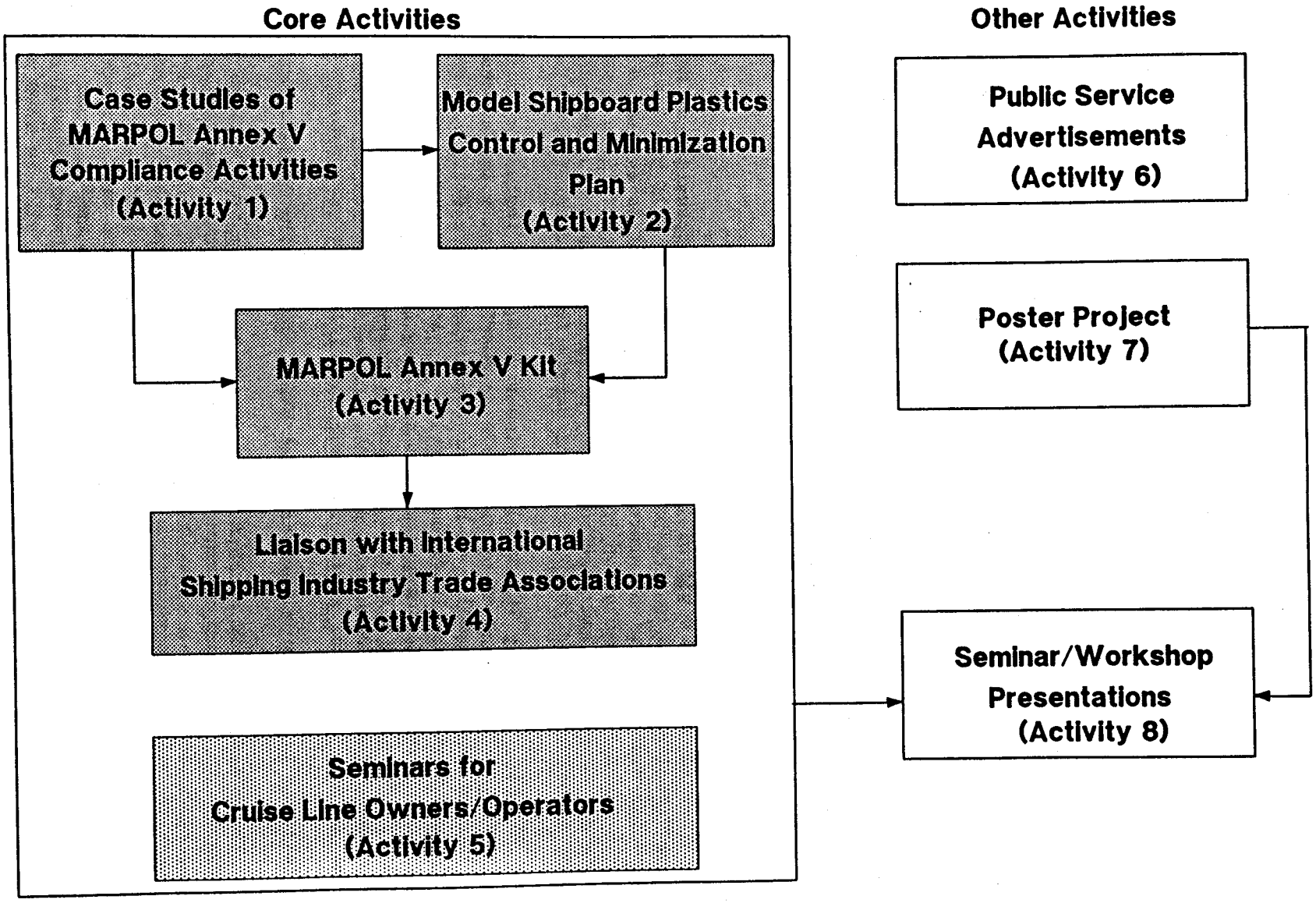

Figure 2.--Shipping industry marine debris education plan overview.

Activity 2: Model Shipboard Plastics Refuse Control and Minimization Plan

Each company will need to determine how to handle garbage under MARPOL Annex V. To facilitate that process, some documentation is needed on what to consider in developing strategies for plastic garbage disposal. A formal plastics refuse control and minimization plan can be an important component of a company's policy on garbage handling.

The model plan will outline the development of waste management procedures and the content and possible formats of a plastics refuse control and minimization plan. It will include techniques for increasing crew awareness of the consequences of marine debris and entanglement, and will use existing marine debris education materials. The model plan will be based on experiences profiled in the case studies and in existing waste management plans. Key contact interviews also will be used.

It should be noted that the Coast Guard will require certain vessels to have a waste management plan. Coast Guard guidance will be sought during the preparation of the model plan. However, the model plan may not be fully in keeping with Coast Guard requirements because it is likely to be completed before the Coast Guard issues instructions on the requirements for waste management plans.

Activity 3: MARPOL Annex V Kit

The MARPOL Annex V kit will assemble existing information on MARPOL Annex V implementation in the United States. The kit will provide a focal point for discussion with international groups on what is available on MARPOL Annex V implementation in the United States, and will be a product which can be printed and distributed by different groups (for example, trade associations and the NMFS Marine Debris Information Offices).

The kit, probably in looseleaf binder form, will include such things as the Coast Guard compendium of materials on MARPOL Annex V implementation in the United States, examples of how the requirements are being implemented by different types of vessels (from Activity 1), and guidance on how to set up shipboard waste management procedures and crew awareness training (from Activity 2). The kit will also include examples of existing marine debris education products (brochures, posters, stickers) that can be used on vessels for training or reminders about MARPOL Annex V requirements.

Activity 4: Liaison with International Shipping Industry Trade Associations

There are too many foreign flag vessels operating in U.S. waters to approach each owner and operator directly. However, the international shipping industry trade associations can be used as an indirect means of contact with foreign commercial shipping owners and operators. Personal contact, such as has been used with shipping industry trade associations in the United States, is more effective than telephone and mail contact in soliciting cooperation and exchange of information on MARPOL Annex V implementation. Meetings will be requested with the international shipping trade associations located in London. These meetings will be used to: 1)

make the associations aware of the marine debris education and MARPOL Annex V implementation materials available, 2) encourage them to publish announcements of marine debris education products in their trade publications, 3) encourage them to reproduce some of the materials, 4) increase awareness of the marine debris education activities taking place in the United States, and 5) identify specific needs where existing materials and programs may be of help.

Activity 5: Seminars for Cruise Line Owners and Operators

Experience in marine debris education activities has shown that involvement of the targeted group in development of an education program can be effective in making the program a success. This is the first time in a NMFS-sponsored marine debris education program that the cruise industry is the focus of marine debris education activities. Since the number of cruise lines operating in U.S. waters is small, it is possible to approach these companies directly.

Seminars with cruise line owners and operators will be conducted in Miami, San Francisco, and Washington, D.C. Offices of the majority of the cruise lines are located in or near these cities. These meetings will be used to: 1) solicit individual company support for marine debris education activities; 2) identify specific educational activities (e.g., working with the Centers for Disease Control to include marine debris information in procedures for shipboard inspections); 3) identify mechanisms to distribute information (e.g., include information with paychecks or stubs); and 4) develop educational materials or assemble existing materials in cooperation with company and industry representatives.

Other Activities

Activity 6: Public Service Advertisements

Art work and brochures that made up a previously used public service advertising campaign are available. Since there is new interest in marine debris as a result of MARPOL Annex V implementation, there may be new opportunities to place the ads in appropriate trade publications. The art work for the public service advertisements will be offered to editors of shipping, port, and cruise line trade journals.

Activity 7: Poster Project

There are several posters available which could be used on ships or in port areas as reminders of the consequences of plastics in the ocean. Some vessel owners and operators have expressed interest in having posters, and their use would probably increase if more people knew about them. Written announcement about the posters on marine debris will be sent to: 1) Federal agencies with offices in port districts (e.g., Coast Guard, U.S. Customs, U.S. Immigration and Naturalization Service, and Department of Agriculture); 2) port authorities; 3) terminal operators; and 4) shipping companies.

Activity 8: Seminar and Workshop Presentations

Seminar and workshop presentations are a means of reaching different types of audiences and increasing awareness of the problem of marine debris as well as the ongoing activities on MARPOL Annex V implementation in the United States. The Shipping Industry Marine Debris Education Plan and its implementation will be presented at appropriate forums, should the opportunity arise.

SHIPPING INDUSTRY MARINE DEBRIS EDUCATION PLAN IMPLEMENTATION

The Shipping Industry Marine Debris Education Plan will be implemented during a 9-month period beginning in the spring of 1989. The first half of the implementation phase for the core activities (Activities 1-5) will be used to prepare the new marine debris education products and establish a working relationship with the cruise line owners and operators. The second half of the implementation phase will be used to gain acceptance and distribution of the education products. The optional activities (Activities 6-8) will be undertaken throughout the implementation phase as the opportunity arises and time and budget permit.

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CLEANUP PROGRAM IN JAPAN

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ABSTRACT

The amount of marine debris accumulated in Japanese coastal areas has showed an increasing trend from the early 1970's, and this debris has become an obstruction to fisheries operating there, causing destruction of habitats of target species and interfering with fishing operations. In fiscal year 1973, the Fisheries Agency started a program to cope with these issues in coastal areas.

This program consists of two activities. One is the education of local residents including fishermen, and the other is the actual cleanup of the seashore and sea bottom. There are three parts to the cleanup activities: cleaning up the seashore using manpower, cleaning up the fishing grounds using trawl nets, and cleaning up the rocky bottoms using divers.

Cleanup activities were carried out in 137 areas in fiscal year 1987, at a cost to the Japanese Government of ¥342,249,000 (US$2,738K).

INTRODUCTION

From early times, the Japanese have shown keen interest in various types of drifting objects stranded on beaches. In some places, people even developed habits of worshipping strange-shaped pieces of driftwood as deities. In coastal areas where the Kuroshio passed, people picked up coconuts which drifted ashore on rare occasions and dreamed of islands far to the south.

In recent years, however, great changes have been observed in the types and quantity of debris. Debris items were no longer objects of veneration as in past times but were a nuisance, causing damage to people's livelihood.

In R. S. Shomura and M. L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, 2-7 April 1989, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFSC-154. 1990.

PROGRAM BACKGROUND

In the early 1970's, complaints were voiced by fishermen in various parts of Japan that wastes stranded ashore or accumulated on the sea bottom were causing serious damage to fishing activities. Such wastes ranged from man-made objects, including bottles, bottle covers, cans, worn-out tires, plastic bags, and other disposed plastics, to natural objects such as grass, wood, and vegetable garbage carried by rivers after torrential rains. Damage assumed to be caused by debris was varied, according to the fishermen. Some extremists contended that debris not only obstructed fishing operations but even caused a decline in the number of fish as a whole. Fishermen presented these problems in all earnestness because they were experiencing direct economic losses.

The damage seeming to have most apparent causal relations with wastes is summarized as follows:

1. Damage to organisms. Plastic bags attached to rocks on the sea floor (the natural habitat for seashells) make it impossible for the seashells to live there. Nondegradable wastes accumulated in shallow water deprive fish of spawning and nursery grounds. Fishing lines, cut or abandoned at sea or on the beach, break seaweed and entangle seabirds.

2. Damage to ships. Plastic bags obstruct engine cooling water intakes. Lost or discarded nets entangle propellers.

3. Damage to fishing activities. Plastic bags caught in trawl net meshes increase water resistance and thereby damage fishing gear. Increased resistance of gear in the water lessens energy efficiency of fishing vessels and increases fuel cost.

   Much time is required to sort out fish from debris caught in trawl nets, cutting down on fishing efficiency. Also, fish taken together with debris frequently bring a lower price.

4. Others. The scenery of beaches is affected, giving an unfavorable impression to visitors who come for sea bathing.

   Besides reports on damage, proposed solutions came from various parts of the country. These included requesting the public not to dispose of garbage in the sea and actively collecting debris being accumulated on beaches and the sea floor.

   However, several problems complicated the solution. First, there was the difficulty of identifying who actually discarded the wastes. The wide range of potential contaminators included ordinary residents, factories, tourists, ships, and fishermen themselves. Therefore, it was impossible to identify the actual polluters and have

them bear the cost of the damages. Second, the effort of people in any particular area is not sufficient to solve the problem. As marine debris comes from various areas including inland areas and areas hundreds of miles away, a number of municipality offices need to cooperate in efforts against this problem.

ESTABLISHMENT OF THE PROGRAM

In fiscal year 1973, the Fisheries Agency launched a program (hereafter referred to as the "Cleanup Program") aimed at preserving the marine environment and recovering deteriorated fishing grounds. The Fisheries Agency formulated and coordinated the entire program, while regional authorities for each area concerned were responsible for the actual implementation.

Contents of the Program

As for specific program items, local authorities were entitled to select from among the following options, giving due consideration to issues peculiar to their own areas:

1. Alert regional residents including fishermen to the need to preserve the marine environment, conducting appropriate educational activities through television and radio broadcasting and newspapers as well as through calls from aircraft, lectures, public ads, posters, leaflets, calendars, and bathing caps and towels.

2. Cleanup debris accumulated on the sea bottom using trawl vessels.

3. Cleanup debris on the rocky bottom using divers.

4. Eliminate wastes drifting on the sea surface using dipnets.

5. Cleanup the beaches using manpower.

6. Use manpower and machines to cleanup rivers and lakes.

7. Establish councils composed of local authorities, fishermen, and academics to formulate specific cleanup programs.

National Budget for the Program

The cost of implementing the Cleanup Program is covered in part (usually half of project costs) by the National Government, with the remaining amount shouldered by local authorities actually enforcing the program. The government budget for this purpose increased annually, the subsidy for fiscal 1973 (April 1973-March 1974) being ¥96,000,000 (US$768K), rising to ¥401,126,000 (US$3,209K) in fiscal 1979. After that the budget remained more or less unchanged (Fig. 1).

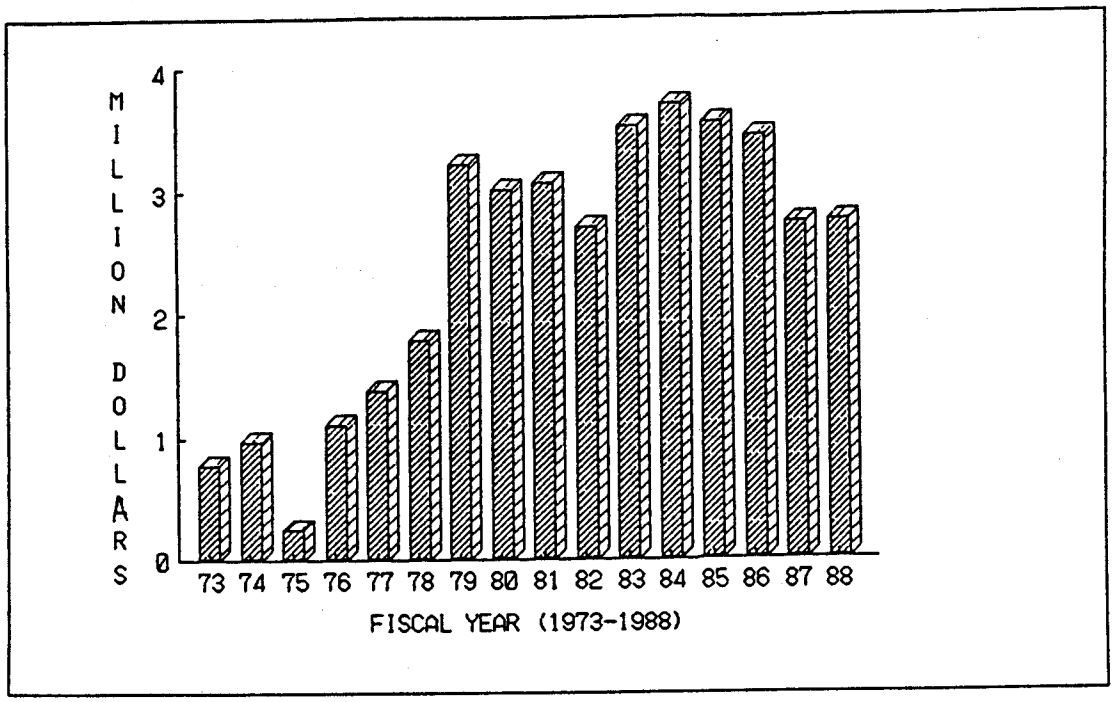

Figure 1.--Annual changes of subsidy under the government budget for the Cleanup Program.

CLEANUP TODAY

At a cost to the national treasury of ¥342,249,000 (US$2,738K) in fiscal year 1987, the program was conducted in a total of 132 areas throughout Japan. The number of areas differed in different prefectures. Some prefectures conducted the program in as many as 23 areas, while some did not carry out any program (Fig. 2).

Following are actual situations in four areas during fiscal year 1987 and the cleanup programs in each area (Fig. 3).

Mutsu Bay, Aomori Prefecture

Mutsu Bay measures about 1,660 km^2, with a total coastline extension of 251 km. Fishing is a major industry there, notably the scallop fishery, with production worth about ¥13 billion (US$104 million) in fiscal year 1987. In 1975, a large number of scallops died of an unidentifiable cause in the bay, which up to then was known for its relative cleanliness. This incident prompted local fishermen to request measures to preserve the fishing ground environment, and a cleanup program was implemented in the same year.

In 1987, cleanup activities were conducted in 10 towns and villages covering more or less the entire coast of the bay at an overall cost of ¥11,640,000 (US$93,120). The scale of the program has been about the

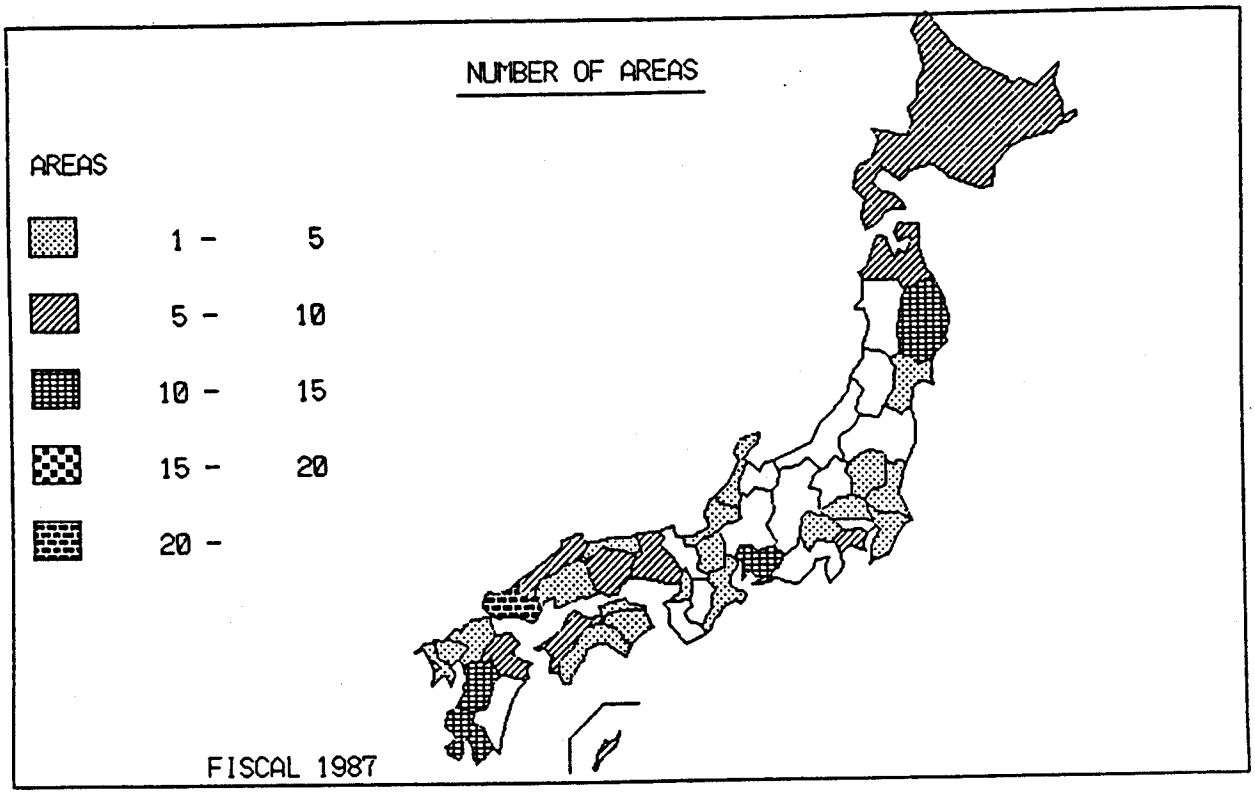

Figure 2.--Distribution of prefectures taking part in the program, shown by number of areas in which the program was conducted in 1987.

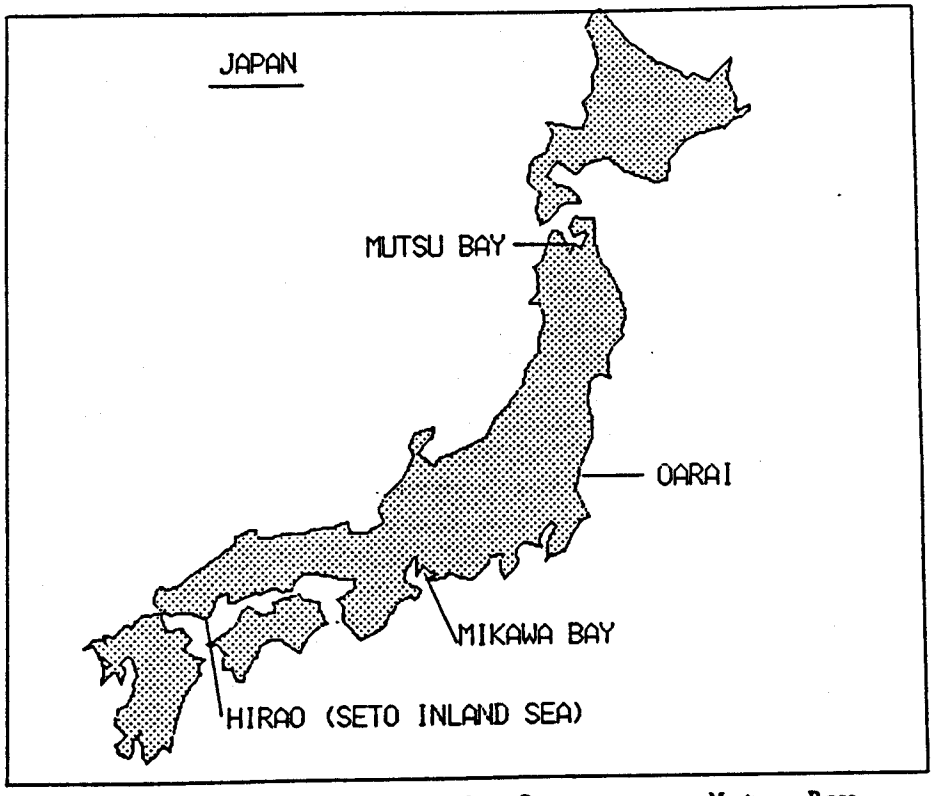

Figure 3.--Location of the four areas: Mutsu Bay, Oarai, Mikawa Bay, and Hirao.

same ever since. The program consisted of three major parts: cleaning up the beach, cleaning up the sea bottom, and conducting educational activities.

Beach cleaning was carried out for several days in July and August, with a total of 5,872 residents taking part, including fishermen, housewives, and students. Each participant was supplied with a pair of cotton gloves and a garbage bag, and wastes gathered totaled 356.2 metric tons (MT). Major components were wood fragments and seaweed. Combustible wastes were incinerated at the beaches, and incombustible items were transported by truck to garbage storage areas of local authorities to be used as landfill.

Sea bottom cleaning was conducted for several days mainly in July, with a total of 2,089 small-sized beam trawlers participating. Fishermen used their own nets for collection of wastes. Debris collected amounted to 163.8 MT, and consisted mainly of used cans and seaweed. There was a larger percentage of seashells and used cans than other wastes on the beaches. All the debris was transported to local authorities' garbage storage areas and landfills.

Educational activities were mainly targeted at elementary school pupils and junior high school students with a view to achieving long-term effects. Guidance on the importance of preserving the marine environment was extended in the course of ordinary school curriculums, and pupils and students were encouraged to make posters and catchphrases contributing to environmental preservation. A total of 1,146 posters and 1,904 catch-phrases on marine environmental preservation were collected from the children at 37 schools from July to September 1987. Excellent works were publicly commended with commemorative awards worth ¥3,000-5,000 (US$24-25) (including a book of gift coupons and a painting set). These were distributed for public presentation in the towns and villages concerned. This program has been established as an annual event in the area.

Oarai, Ibaraki Prefecture

Oarai is a Pacific coast town with a population of 21,000, and its major industries are tourism and a coastal fishery. Located relatively close to the Tokyo metropolitan area, Oarai has seen rapid urbanization during the past few years. The amount of wastes has been rising, making their disposal increasingly difficult despite the municipal authorities' effort. The town is situated at the mouth of a big river (Nakagawa River), and it has been pointed out that a great amount of debris flows into the sea from the river. Fishermen are worried that sardine fry, caught with trawl nets, can be easily damaged by garbage netted simultaneously. In the summer, about 8 million people visit this town for sea bathing. The municipal authorities have a hard time disposing of used cans and bottles generated by these seagoers.

Sea bottom 15-30 m deep and totaling 7.84 km^2 was cleaned on 18 January and again on 20 February 1988 using 57 small (5-ton) trawlers. Fuel expenses of ¥5,400 (US$43) and ship depreciation expenses of ¥22,000

(US$176) per day were provided to each vessel. Fishermen used their own trawl nets for cleaning activities. The program was conducted during off seasons of the coastal trawl fishery to avoid an unnecessary by-catch of fish. As a result of the cleanup, 15.5 MT of debris, mostly used cans and plastic bags, were collected and removed to a landfill.

Since the Cleanup Program was launched in 1974, fishermen have seen a decrease in the amount of debris caught in their nets, and they have become increasingly active in many areas in this region.

Mikawa Bay, Aichi Prefecture

Mikawa Bay, with an area of 604 km^2 and an average depth of 9 m, is a closed area with poor tidal interchange. At the back are located industrial and urban areas, and many rivers which run through these areas flow into the bay. Major industries of the bay area are fishing and tourism, with a resort business targeted at sea bathers.

In cleanup activities implemented in fiscal 1987, a total of 464 residents in 8 areas cleaned up the 30.9 km coastline along the bay, collecting 5,810 kg of wastes from 120,000 m^2 covered. Principal debris was wood fragments, cans, and bottles (Fig. 4). All the debris collected was either taken to a landfill or incinerated. A total subsidy of ¥1,000,000 (US$8K) was granted, and was used for purchasing commemorative items, gloves, polyethylene bags, and fuel for incinerating waste.

Hirao, Yamaguchi Prefecture

Hirao is an agricultural and fishing town with a population of 15,000, facing the Seto Inland Sea. The Seto Inland Sea is the largest of its kind in the country, with a latitudinal extension of 445 km, a longitudinal extension of 15-18 km, and a total area of 2,200 km^2. The average depth is relatively shallow at 37.3 m. This is an area of serious concern when it comes to marine environmental pollution, as it is a closed area and has a population of 29,359,000 along the coast.

Impressive educational activities are being carried out in Hirao. With the collaboration of residents, an experiment was conducted to find out how the garbage arrived at the town by way of sea currents and winds, and where the garbage originating in the town goes. This experiment is known among the residents as "Coconut Strategy," with the capsules used in the experiments being thought of as coconuts. In July 1987, 25 plastic capsules 10 cm in diameter and 40 cm long were set adrift from 25 points along the coast within a radius of 50 km from the center of the town. Posters were placed in the town and surrounding areas in order to draw the attention of residents and ensure that reports would be made when the capsules were found on beaches. So far, a total of 15 capsules have been recovered. Around the areas where capsules were released, the results were publicized using posters saying, "The capsule released from your town arrived at such-and-such an area. This means if you discard garbage into the sea, it will possibly drift to that area and cause trouble. The sea does not belong only to you. Please take heed not to contaminate the sea."

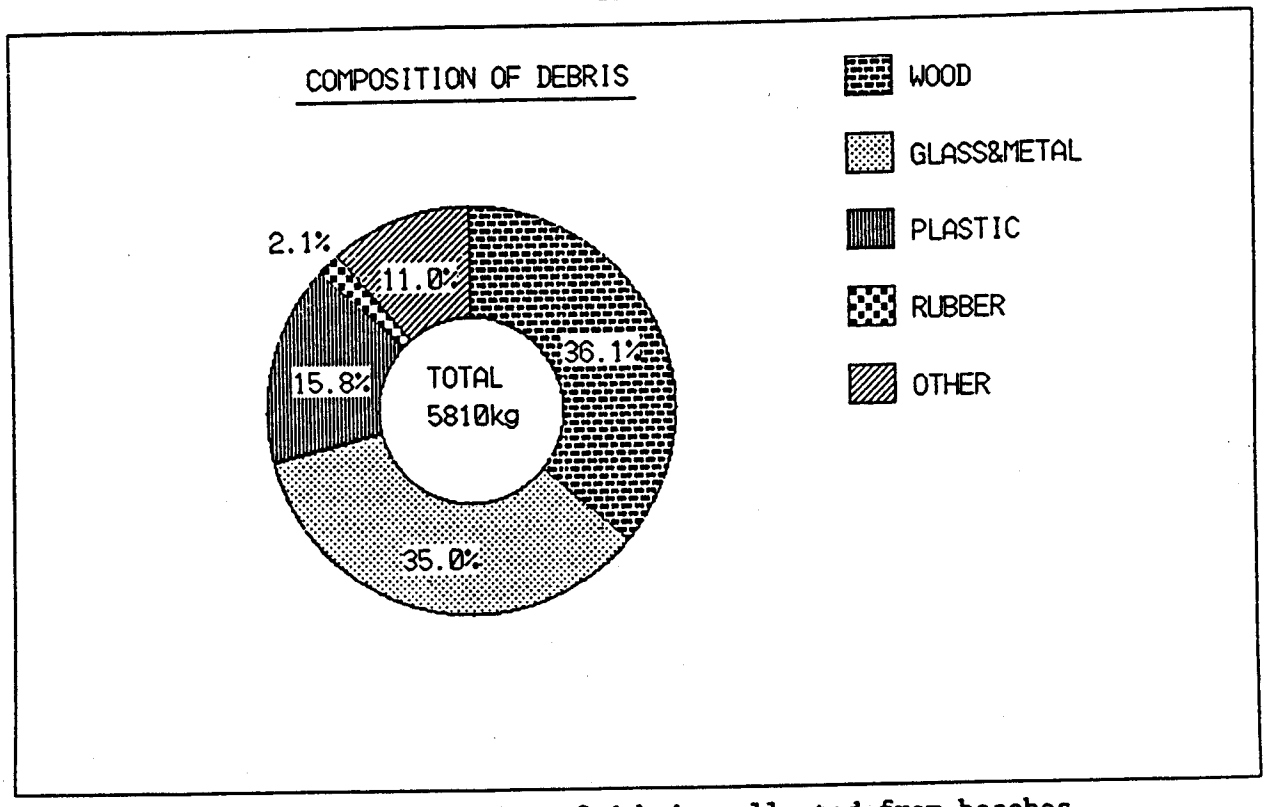

Figure 4.--Composition of debris collected from beaches during the cleanup of Mikawa Bay in July 1987.

A total of ¥322,000 (US$2,576) was used for producing capsules and posters and for other purposes.

The campaign has grown as town residents have begun to realize the need to raise public ethical standards, and an increasing number of people are participating.

DISCUSSION

Effects of the Program

The Cleanup Program was initiated under the leadership of the administrative authorities, but in many cases, programs were taken over willingly by local residents as years passed.

People's interest has grown as the educational programs have continued, and many people hope that the programs will carry on. Some communities have even formulated their own new and voluntary initiatives, in addition to the basic guidelines. One such example is the establishment of "Fishing Ground Preservation Month," during which stepped-up publicity is conducted.

There have been two different views concerning the effects of the Cleanup Program. One recognizes the effectiveness of the program based on

the fact that the amount of garbage has been steadily declining since the program was launched. The other questions the effectiveness of the Cleanup Program, pointing out that the garbage amount has not decreased substantially even after several years. These differences are due to the fact that the pace of waste accumulation differs from area to area, that amounts collected are subject to weather and sea conditions, and that it is difficult to assess the effects of the program quantitatively. However, even people taking the latter position believe that implementation of the Cleanup Program contributes to an increase in public awareness of environmental preservation. It is therefore concluded that the program as a whole has been significant.

Future Themes

Some future tasks have been pointed out that will improve the effectiveness of the program. First is the need to conduct the program in a comprehensive manner covering a larger area than at present. In many cases, cooperation in the present program has been limited to the level of muncipalities along a bay area. In order to cope with environmental problems covering the vast ocean, it will be necessary to step up and expand collaboration. Further, it will be no less important to expand the scope of the program to inland areas. A considerable amount of wastes generated by the people in those areas is transported through rivers to the sea. Garbage originating inland can accumulate on the beaches.

Second, it is necessary to hunt for new ways to promote a voluntary environmental preservation campaign. One potential method is to install garbage processing facilities in areas where individuals voluntarily collect wastes. Such support is expected to further increase the local communities' awareness of the need for environmental preservation. Lastly, some technological problems need to be solved. Although the program does not require any special technology, some problems have arisen as a result of its actual implementation. These include the disposal of incombustible objects containing large amounts of sand and seawater (salt water) and the elimination of wastes accumulated around complex bottoms or man-made structures such as artificial and natural reefs.

ACKNOWLEDGMENTS

We express our gratitude to all those who are striving to promote the Cleanup Program. Special appreciation is due to Messrs. Nagatsu of Aomori Prefecture, Chinone of Ibaraki Prefecture, Matsui of Aichi Prefecture, and Asaka of Yamaguchi Prefecture, who collaborated in collecting materials.

U.S. NAVY'S PLASTICS WASTE EDUCATIONAL EFFORTS

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ABSTRACT

The U.S. Navy is responding to the at-sea plastics discharge prohibition in the Marine Plastic Pollution Research and Control Act with a program that includes new shipboard solid waste management equipment, changes in the supplies taken on board, and educational efforts.

Basic strategy of the Navy's plastics waste education program focused on motivating the entire chain of command, ships' officers, and ships' crews by providing justification for and information about the new requirements.

Before designing an effective shipboard plastics waste management program, it was necessary to learn (1) the nature and quantities of plastics waste on Navy ships, (2) feasible shipboard plastics waste management practices, and (3) sailors' attitudes about plastics pollution control. The Shipboard Plastics Waste Reduction Demonstration Project gathered this information on seven ships. Then, using recommendations from an ad hoc advisory committee on plastics and actual experiences on the demonstration ships, the Navy designed an educational package to send to all Navy ships.

The Navy's plastics education package includes guidance material, videotapes, posters, and general literature. To educate the ships' officers, a ship's guide contains chapters on (1) problems caused by plastics in the oceans, (2) Navy

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requirements, (3) essential elements of a successful shipboard program, (4) example approaches used on the demonstration ships, and (5) general information about related issues. Appendixes to the guide include lists of common plastic and substitute nonplastic items, sample ship instructions to implement the program, descriptions of other materials in the package, and Navy points of contact for further information. To education the crew members, a 10-min videotape explains the problem, the Navy's program, and appropriate shipboard actions. A series of 30-sec videotapes and written announcements highlight specific aspects of the problem and the program.

Preliminary responses to the education package from Navy ships are very positive.

INTRODUCTION

Impetus for Navy's Plastics Program

Recent and unexpected national regulatory initiatives caused the U.S. Navy to quickly develop and implement shipboard plastics waste management programs. The Navy anticipated more stringent international regulations affecting solid waste disposal at sea, but not a prohibition on plastics discharge.

Annex V of the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships (MARPOL), prohibits disposal of all plastics, and restricts discharges of all types of solid wastes, into the sea from ships. Public vessels are exempt from Annex V restrictions but are expected to comply to the extent possible. However, the U.S. Congress, in passing the U.S. Marine Plastic Pollution Research and Control Act of 1987 (P.L. 100-220), made the plastics discharge prohibition apply to the U.S. Navy. The Congress is requiring the Navy to comply within 5 years or demonstrate why it cannot.

For decades the Navy has worked to eliminate the discharge of floating marine debris from its ships, and for the last 5 years, has been developing suitable shipboard equipment for pulping, compacting, and processing all solid waste (Alig et al. 1990). The equipment will convert all shipboard solid wastes to acceptable forms for overboard disposal at prescribed distances from shore. However, plastics waste would have been processed along with other solid wastes, so the new requirement to eliminate plastics waste disposal at sea created an unexpected and difficult challenge.

Ad Hoc Plastics Advisory Committee

The Navy formed an ad hoc committee on plastics to develop recommendations for reducing plastics waste discharge from Navy ships, and in October 1988, the committee presented its report to the Assistant Secretary at a Washington, D.C., news conference. The report contains 42 recommendations covering 4 areas: supply system, technology, ship operations, and education.

The Navy's shipboard pollution abatement program was already addressing most of the committee's technology recommendations as part of the shipboard solid waste management program. The recommendations in the areas of the supply system, ship operations, and education, however, embodied major changes in Navy practices. Nevertheless, the Navy began implementing many of the recommended actions to help reduce plastics discharge at sea.

Following are the six recommendations made in the area of education:

1. Disseminate information on the plastics problem and the Navy's plans to all levels in the Navy.

2. Develop education materials for ships, supply centers, and procurement offices.

3. Use an education package composed of several key elements on every Navy ship.

4. Assess effectiveness of education efforts through a survey.

5. Use the Navy's environmental award to recognize outstanding ships for their efforts to reduce plastics waste.

6. Sponsor shipboard contests on plastics reduction methods.

Navy Actions

The Navy has already taken significant actions to control plastics pollution at sea. As examples, fleet commanders ordered all ships to separate plastics from nonplastics waste on board and return the plastics waste to port for disposal or recycling. Supply centers have replaced plastic items with nonplastic ones on ships wherever possible. The Chief of Naval Operations office sent a plastics education package to all ships. This paper describes the Navy's initial efforts to educate ships' officers and crews about the new requirement to eliminate plastics waste at sea.

GUIDING PRINCIPLES

The key to success for a new Navy program is to motivate the chain of command and the sailors to participate fully. But in the case of the plastics waste program, the entire chain of command also had to support the program, both financially and authoritatively.

Before the top echelons of the Navy's chain of command would impose such drastic measures as storing wastes on Navy warships, they needed evidence showing shipboard plastics waste programs to be feasible, effective, and safe. Therefore, we had to assess the feasibility, effectiveness, and safety of potential shipboard plastics waste management practices before we could propose a program concept that the chain of command would support.

The program needed careful planning and coordination among many diverse Navy organizations (e.g., Office of the Chief of Naval Operations,

Fleet Commands, Naval Sea Systems Command, Naval Supply System Command, and Navy laboratories). Even then, edicts and emotional appeals do not ensure a successful program. For drastic changes in shipboard waste management practices, a variety of motivation techniques would be needed to get full cooperation on ships. Some officers and crew would be sufficiently motivated by direct orders. Others might respond to the military benefits of new procedures. Sound explanations of the reasons for new requirements would suffice for some. Still others would get personally motivated by appealing to their sense of pride or the need to protect wildlife.

Our guiding principles, then, in developing the educational program were to invoke as many response stimuli as we could.

EDUCATION OF NAVY PROGRAM MANAGERS

Successful reduction of plastics discharge from Navy ships requires two educational efforts. One is educating the Navy chain of command about what shipboard practices are feasible and effective. The other is educating ships' officers and crews about the new practices. To achieve the first step, the Navy needed to learn (1) the nature and quantities of plastics waste on Navy ships, (2) feasible shipboard plastics waste management practices, and (3) sailors' attitudes about plastics pollution control. In 1988, the Navy's Shipboard Plastics Waste Reduction Demonstration Project began collecting this information.

During the demonstration project, Navy researchers traveled on seven ships to quantify shipboard plastics waste, and evaluated prototype equipment and plastics waste management procedures. They sorted and inventoried all plastics waste generated on board. On two ships they evaluated Navy-developed prototypes of a trash compactor and a waste pulper. Other researchers surveyed the crews' knowledge about the plastics problem.

The preliminary conclusions from the demonstration project regarding an education effort are the following:

- Sailors are generally receptive to the major new requirement to separate and store plastics waste on board, once the problem with plastics in the oceans is explained to them.
- The mission, size, crew density, and operating characteristics of different ships differ so much that a single set of prescribed plastics waste management procedures is not appropriate for all ships.
- Ships prefer to find their own approaches to meeting the requirements, i.e., be told what to do, not how to do it.

EDUCATION OF SHIPBOARD PERSONNEL

Development of Education Package

Initially, we planned to prepare a prototype educational package and test its effectiveness on several demonstration ships before sending it to

all Navy ships. However, the Commander of the Atlantic Fleet took a personal interest in the plastics problem and pushed for faster implementation of shipboard programs. His staff prepared instructions for ships to retain plastics waste on board to the extent practicable. He wanted an educational package sent to ships before he would issue the new instructions. Consequently, we had to assemble educational materials quickly without knowing exactly what shipboard procedures were feasible and what educational materials would be effective on ships.

Our basic strategy for the educational package targeted two audiences on ships: executive officers and crew members. We prepared a ship's guide and a new videotape, and supplemented these two key items with available literature, posters, brochures, and videotapes.

The ship's guide serves as a compilation of useful information about the new requirements and suggestions for implementing a shipboard program. To allow ships' officers and crews to find their own ways of meeting the new requirements, the material was presented as a guide, not an instruction.

Because closed circuit television is the prime source of news and entertainment on ships, we believed that videotapes would be the best way to influence and communicate with sailors. Therefore, the Navy produced new videotapes that focused specifically on the Navy's role in the plastics problem. As a general overview, we prepared a 12-min tape that covers all aspects of the problem and the Navy's program. To add authority and credibility to the new requirements, the Vice Chief of Naval Operations made a 3-min statement on videotape. To keep the issue visible to the sailors and reiterate the theme of the plastics program, we produced a series of 30-sec tapes that could be shown on board between movies. For variety, we included in the package existing videotapes produced by other organizations.

Contents of Education Package

The Navy's plastics waste educational package that was sent to all ships included the following items.

- "Ship's Guide to Recent Navy Initiatives for Shipboard Solid and Plastics Waste Management" (U.S. Navy).
- Videotapes in Beta and VHS formats with six selections:
  - "Plastics At Sea, More Than a Litter Problem" (12 min, U.S. Navy).
  - Statement by Admiral Edney, Vice Chief of Naval Operations (3 min).
  - Eight 30-sec public service-type announcements (U.S. Navy).

  - Navy Broadcast News segment on the plastics problem (7 min).
  - ABC News excerpt on ocean pollution (3 min).
  - "Trashing the Oceans" (7 min, U.S. National Marine Fisheries Service).
- "A Citizen's Guide to Plastics in the Ocean: More Than a Litter Problem" (Center for Environmental Education, Washington, D.C.).
- Three posters:
  - "Don't Splash Navy Trash--Others Can Pick It Up" (U.S. Navy).
  - "Our Ocean Is Drowning" (U.S. National Marine Fisheries Service).
  - Photograph of large plastic bag of trash with narrative (Center for Environmental Education, Washington, D.C.).
- "Our Water Planet is Becoming Polluted with Plastic Debris" (brochure prepared by U.S. National Marine Fisheries Service).

The Navy's videotape "Plastics At Sea, More Than a Litter Problem" explains the problems caused by plastics in the oceans, the Navy's overall program for shipboard solid and plastics waste management, and what actions are needed by each ship and crew member. The tape is narrated by an actor in an enlisted man's uniform and contains footage of healthy marine life, entangled animals, Navy ships, shipboard scenes, and computer graphics. To appeal to sailors, segments of the Huey Lewis videotape "Perfect World," showing his band singing in a huge garbage dump, appear throughout the tape.

The ship's guide is similar to a citizen's handbook, except that it contains information applicable to Navy ships and the Navy's plastics waste program. The guide is approximately 50 pages long, with 6 chapters and 9 appendixes. Chapter 1 (Introduction) briefly describes the problems caused by plastics at sea and the international and national regulations restricting disposal at sea. Chapter 2 (Navy Requirements) explains the major changes needed in shipboard solid waste management. Chapter 3 (Essential Elements of Successful Shipboard Program) emphasizes that a shipboard program needs comprehensive operational changes, leadership, crew education, constant reinforcement, and clear definitions of responsibilities. Chapter 4 (Example Approaches Used on Demonstration Ships) provides suggested procedures for ships to use in their own shipboard plastics waste program, based on successful and unsuccessful approaches used on the demonstration ships. Chapter 5 (Medical Wastes) describes the new requirements for managing medical wastes on board. Chapter 6 (Status of Related Issues)

addresses three topics related to the plastics program: degradable plastics, shipboard incinerators, and commercial products.

The nine appendixes are a collection of miscellaneous items to help executive officers develop their ship's program. We provided lists of common plastic items on ships and the available nonplastic substitutes. Brief synopses of information about the plastics problem, sources of marine debris, legislation, and the Navy's program are included as sample "Plan of the Day" announcements for executive officers' use in keeping the program visible to crews. Included also are example ship instructions for implementing a shipboard program and an example message report for reporting any necessary plastics discharge at sea. Other appendixes describe the contents of the educational package and give Navy points of contact for additional information.

PRELIMINARY OBSERVATIONS ON EFFECTIVENESS OF PACKAGE

The Navy sent complete educational packages directly to all ships in the U.S. Fleet in early 1989. Preliminary responses to the education package are very positive. The combination of useful information and multimedia motivational techniques in the package seems appropriate for Navy ships. Each item in the package seems useful for one or more purposes. However, the two items specifically prepared by the Navy for the education package (i.e., ship's guide and videotape) are the most valuable.

The Navy will continue its shipboard plastics educational program and extend it to shore facilities. Plans to modify the videotape and distribute it to shore facilities are ongoing. The future direction of the program will depend on the success of the initial effort and the need to modify the program.

CONCLUSIONS

The requirement for U.S. Navy ships to separate and retain plastics waste on board is so new and the educational packages were distributed so recently that any conclusions about the effectiveness of the program would be premature. However, from our experiences so far, we make the following observations:

1. Sailors generally respond positively to the plastics waste program and the educational materials. We believe the general environmental awareness and young age (average age is about 20 years) of Navy sailors are major factors affecting the positive response.

2. High quality videotapes are an effective means for communicating with shipboard audiences. However, useful guidance material about specific procedural details must accompany the videotapes.

3. Attention by the entire chain of command is needed for successful program implementation.

4. Edicts, emotional appeals, and good educational materials do not ensure successful shipboard plastics waste programs. The program must be carefully planned, coordinated, and implemented. Proposed new plastics waste requirements must be first proved feasible, effective, and safe on ships for the program to succeed.

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HOW MUCH DO COMMERCIAL AND RECREATIONAL FISHERMEN KNOW ABOUT MARINE DEBRIS AND ENTANGLEMENT? PHASE 1

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ABSTRACT

Education is assumed to be a cost-effective method to encourage shoreside disposal of plastics and other garbage. To test this assumption, a demonstration project is under way at four sites to develop, test, and evaluate marine debris education as a technique for changing the waste management practices of commercial fishermen and recreational boaters. The project is structured in three phases: 1) a baseline survey of commercial fishermen and recreational boaters on their garbage disposal practices and perceptions of the problems of marine debris and entanglement; 2) a targeted marine debris education program for the survey groups at three of the four sites; and 3) a survey of the same groups used in phase 1 on their garbage disposal practices and perceptions of the problems of marine debris after the education program. The project sites are: Bayou La Batre, Alabama; Martin County, Florida; Hampton, Virginia; and Taylor County, Florida. Phase 1 of the project was completed in the spring of 1989. Commercial fishermen and recreational boaters at the four sites were asked questions in six areas: 1) current garbage disposal practices, 2) experiences with plastic marine debris, 3) opinion on the problems caused by plastic marine debris, 4) knowledge of laws on at-sea garbage disposal, 5) opinion on ways to encourage shoreside disposal of plastic garbage, and 6) background information. Results of the phase 1 survey revealed the garbage disposal practices of those surveyed as well as their opinions on and experiences with plastic marine debris.

INTRODUCTION

Annex V of the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73/78) went into effect 31 December 1988. The MARPOL Annex V, formally entitled "Regulations for the Prevention of Pollution by Garbage from Ships," prohibits at-sea dumping of plastics and specifies the distance from shore that all other materials may be dumped. This means overboard disposal of most garbage is no longer an option.

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Enforcement of MARPOL Annex V will be difficult because of competing priorities and limited resources of the Federal enforcement agencies. The success of MARPOL Annex V will depend in part on voluntary compliance.

Education is expected to be a key factor in gaining voluntary compliance with MARPOL Annex V. Education is also assumed to be a cost-effective way of encouraging shoreside disposal of plastics and other debris. To test this assumption, a demonstration project is under way to develop, test, and evaluate a marine debris education project for commercial fishermen and recreational boaters. The project is sponsored by a Saltonsall-Kennedy grant from the U.S. National Marine Fisheries Service. This paper outlines the overall structure of the project. Results of a survey of commercial fishermen and recreational boaters at four sites taken before a targeted marine debris education program are also presented.

METHODOLOGY

The project is structured in three phases: 1) a baseline survey of commercial fishermen and recreational boaters on their garbage disposal practices and perceptions of the problems of marine debris and entanglement; 2) a targeted marine debris education program for the survey groups at three of the four sites; and 3) a survey of the same groups used in phase 1 on their garbage disposal practices and perceptions of the problems of marine debris after the education program (Fig. 1). Phase 1, the initial survey, was conducted in the spring of 1989. Phase 2, the marine debris education program, will be conducted from the spring through the summer of 1989. The second and final survey, Phase 3 of the project, will be conducted in the fall of 1989.

The project is being conducted using four sites: Bayou La Batre, Alabama; Martin County, Florida; Hampton, Virginia; and Taylor County, Florida. Taylor County will serve as the control site. Commercial fishermen and recreational boaters in Taylor County will receive no marine debris education as part of this project, but will be surveyed twice. This approach was taken because some of the education activities cannot be restricted to the survey sample.

These sites were selected after consultation with state natural resource agencies. Other factors considered in the selection process included distance from other known marine debris education projects, prior involvement of the state with the marine debris issue, the ability of the state to provide comprehensive lists of commercial fishermen and recreational boaters, the number of commercial fishermen and recreational boaters, and the opportunity to coordinate marine debris education activities with local events or projects. In Martin County, for example, marine debris education activities will be tied to a fishing tournament.

The survey groups were selected from mailing lists of recreational boat registrations and commercial fishing licenses maintained by state agencies. The goal was to obtain 100 completed surveys at each site for both commercial fishermen and recreational boaters. For each site, an initial sample of 300 individuals with registered motorboats used for pleasure was selected

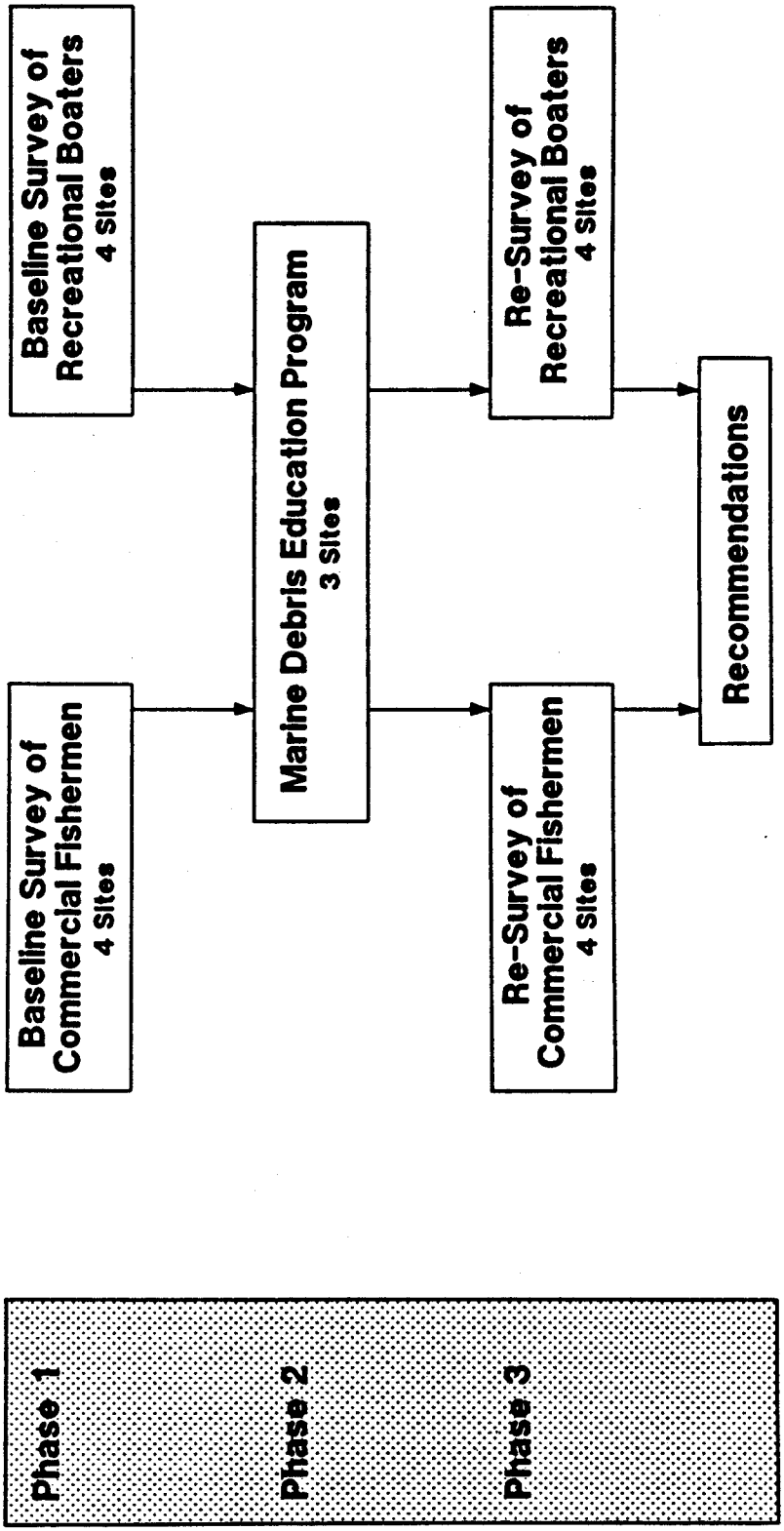

Figure 1.--Overview of project methodology.

using a systematic sampling technique. Surveys returned because of incorrect addresses were replaced with new names drawn using the same sampling technique. An additional sample of up to 150 names was drawn after initial survey returns indicated that fewer than 100 completed surveys would be received. All individuals on the commercial fishing license lists at each site were included in the survey. The number of commercial fishing licenses at the four sites ranged from about 200 to 330. Over 400 surveys were completed and returned--161 (16% of the potential respondents) from commercial fishermen and 257 (20% of the potential respondents) from recreational boaters. The number of completed commercial fishermen surveys ranged from 8% from Bayou La Batre to 21% from Martin County. For recreational boaters, the range was from 7% from Bayou La Batre to 27% from Hampton. None of the sites reached the goal of 100 completed survey forms, although 97 recreational boater surveys from Hampton were completed and returned. The description of the survey responses which follows represents the answers of those responding to the survey only and should not be generalized to a larger population. Unless otherwise noted, the following description of the responses combines the responses from all four sites.

DESCRIPTION OF RESPONDENTS

Commercial Fishermen

About one-quarter of the commercial fishermen responding to the survey were between 30 and 39 years of age. Another quarter of the respondents were 60 years or older. The percentage of income from commercial fishing in 1988 ranged from 0 to 100%, with the average being about 41%. The types of gears used in 1988 in order of percentage of use were as follows: rod and reel (42%), gillnet (38%), traps and pots (26%), tongs (24%), trawl (12%), dredge (4%), and longline (4%). Rod and reel were used at all sites, but most often in Martin County and Taylor County. Gillnets were also used at all sites, but most often in Hampton and Taylor Counties. Surf fishermen and spear fishermen were represented among the respondents from Martin County. Most of the commercial fishermen responding to the survey typically make day trips. However, one or more of the respondents at each of the four sites make longer trips. Some of the trips last up to 14 days at a time. About 28% of the respondents are members of a commercial fishermen's association. Only about 13% of them had participated in an organized beach cleanup in the past 3 years.

Recreational Boaters

The age distribution among the recreational boaters responding to the survey was evenly divided among three groups: 40 to 49 years, 50 to 59 years, and 60 and older. About one-quarter of the respondents fell into each group. About 40% of the respondents fish on every boat trip they make. Only 5% of the respondents never fish from their boats. About 8% of the respondents are members of fishing clubs, and about 11% had participated in an organized beach cleanup within the past 3 years.

CURRENT GARBAGE DISPOSAL PRACTICES

Commercial Fishermen

About 95% of the respondents have one or more trash receptacles on their vessels. The most prevalent types are buckets (52%) and plastic garbage bags (36%). Other receptacles used include trash cans, paper bags, and fish boxes. Only two respondents (1.3%) have compactors and one (0.6%) has an incinerator on board. Over half of the respondents said they consider what plastic items are taken on board which will need to be thrown away. Over 80% of the respondents said they have picked up plastic trash from the ocean, bay, or sound and returned it to shore for disposal. Plastic trash is generally disposed of at home (50%), at the dock or marina (27%), or at the fishhouse (20%). Fewer than 3% of the respondents admitted to disposing of plastic trash in the ocean, bay, or sound. Unwanted gear is generally disposed of at home (54%), at the dock or marina (23%), and at the fishhouse (10%). Fewer than 2% of the respondents admitted to disposing of their fishing gear in the ocean, bay, or sound. Unwanted gear is also left at city and county garbage dumps and landfills, or in dumpsters away from a dock or marina.

Recreational Boaters

Like the commercial fishermen, most recreational boaters responding to the survey have one or more trash receptacles on board their boats. The most common trash receptacles among the respondents are plastic garbage bags (51%) and buckets (43%). Among the other types of receptacles used for trash are coolers and dry and live wells. Over 56% of the respondents said they consider what plastic items will need to be thrown away when deciding what to take on board. About 75% of the respondents have picked up plastic trash from the ocean, bay, or sound and returned it to shore for disposal. Plastic trash from day trips is generally disposed of at home (73%) or at the dock or marina (23%). Fewer than 1% of the respondents said they throw plastics into the ocean, bay, or sound. On overnight trips or longer trips, the respondents generally dispose of their plastic trash at the dock or marina (56%) or at home (38%).

EXPERIENCE WITH PLASTIC MARINE DEBRIS

Commercial Fishermen

The respondents were asked first to identify which of six problems caused by plastic marine debris they had seen or experienced. They were then asked to identify the one they considered to be the most important among the six. Figure 2 summarizes the experience of the respondents with plastic marine debris. More than 95% of the commercial fishermen said they have seen plastic trash floating in the ocean, bay, or sound. This was also identified by the commercial fishermen as the most important problem among the six. About 75% of the respondents said they have seen plastic trash floating near the dock. Many of the respondents have had personal experience with plastic marine debris. Over 45% have had their vessel's propeller caught in plastic. Over 30% have had their gear caught or fouled by

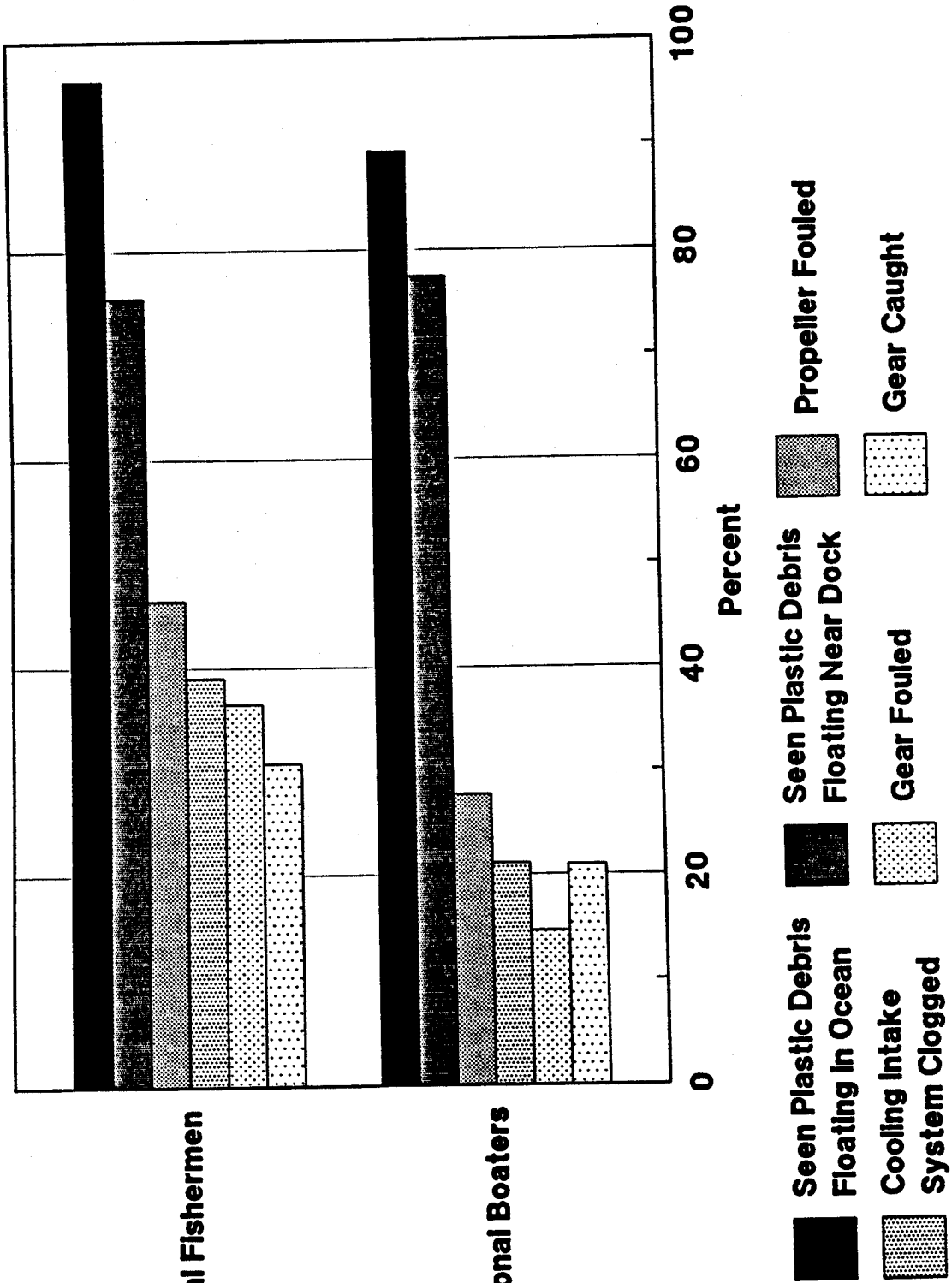

Figure 2.--Experience with plastic marine debris (based on percent of responses to the question).

plastic debris. Almost 40% have had their boat's cooling intake systems clogged by plastic debris.

About 94% of the respondents said they think plastic trash in the ocean, bay, or sound can kill marine animals, create safety hazards for mariners, and wash ashore as beach litter. Personal experience was cited most frequently as the basis for their opinion.

Recreational Boaters

Figure 2 also summarizes the experience of the recreational boaters with plastic marine debris. About 90% of the respondents said they have seen plastic trash floating in the ocean, bay, or sound. This was also cited most frequently as the most important problem. The recreational boaters responding to the survey have also had personal experience with plastic marine debris, but not to the extent of the commercial fishermen. About 28% of the respondents have had their boat's propeller caught in plastic debris. Between 15 and 20% have had their gear caught or fouled by plastic debris. About 21% of the respondents said that their boat's cooling intake systems have been clogged by plastic marine debris.

Almost all of the respondents (97%) said they think that plastic trash in the ocean, bay, or sound can kill marine animals, create safety hazards for mariners, and wash ashore as beach litter. Like the commercial fishermen, personal experience was cited most frequently as the basis of the respondents' opinion.

KNOWLEDGE OF LAWS ON AT-SEA GARBAGE DISPOSAL

Commercial Fishermen

Just over half (51%) of the commercial fishermen said they know there is a Federal law which prohibits disposal of plastics from vessels and restricts the other types of garbage that may be dumped into the ocean, bays, or sounds. The remainder of the respondents were evenly split between those who were unsure and those who did not know about such a law. Word of mouth was cited most frequently as the source of information on this law, followed by magazine articles, television, and newspapers. Among the sources of information on the law specified by the respondents were training by offshore oil and gas companies for their workers and tickets received from the U.S. Coast Guard or marine patrol. Only 5% of the respondents said they have heard of MARPOL Annex V.

Recreational Boaters

Thirty-eight percent of the respondents said they know there is a Federal law which prohibits disposal of plastic trash from boats and limits the dumping of other types of garbage into the ocean, bays, and sounds. About 33% of the respondents were unsure whether there is such a law, and 30% did not know about the law. Like the commercial fishermen, word of mouth was cited most frequently as the source of the respondents' information. This was followed by television, newspapers, and magazine articles.

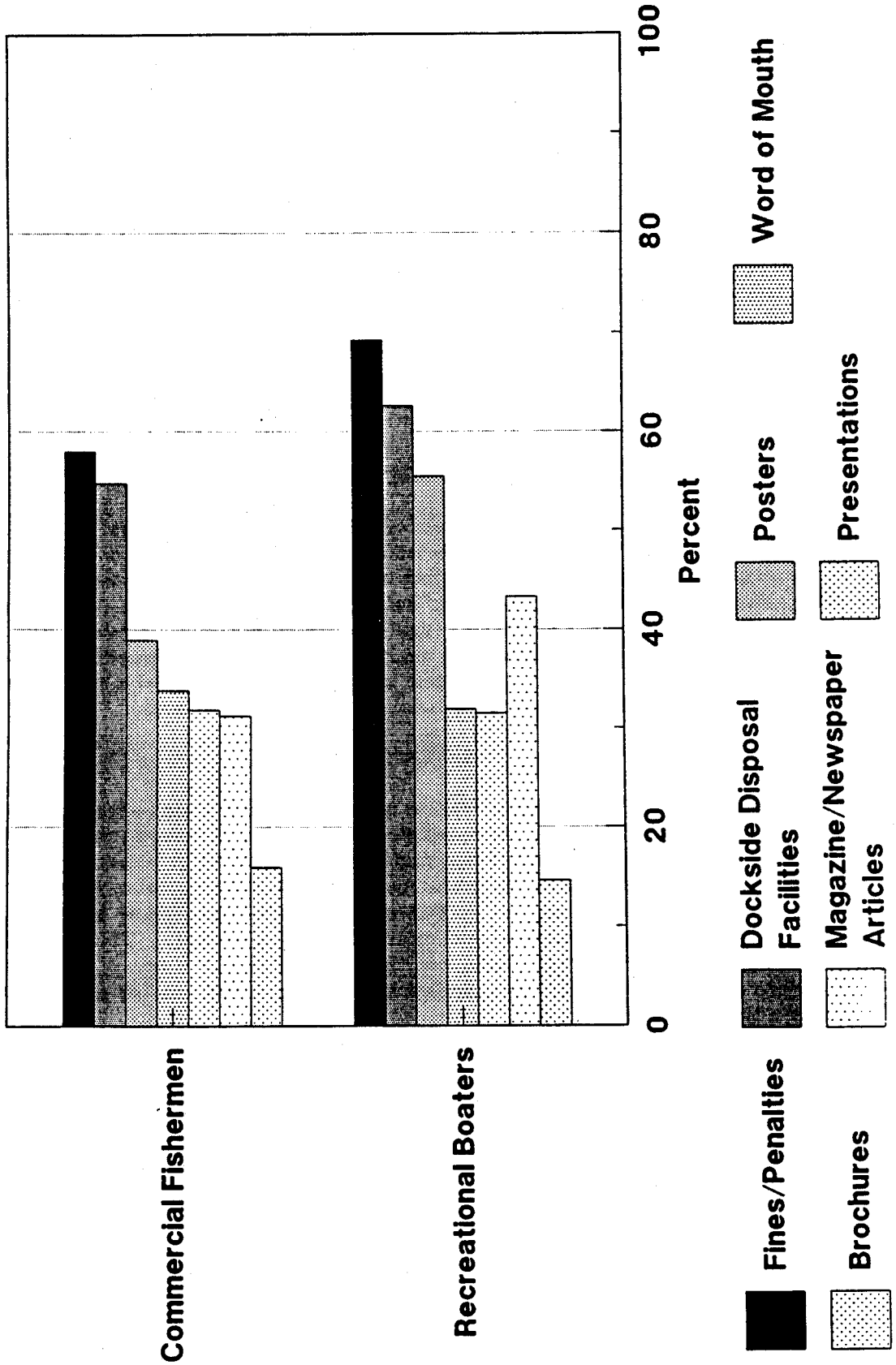

Figure 3.--Best ways to encourage shoreside disposal (based on percent of responses to the question).

The Coast Guard, marine patrol, and training by offshore oil and gas companies were also cited as sources of information on this law. Only 3% of the respondents said they have heard of MARPOL Annex V.

OPINION ON THE BEST WAYS TO ENCOURAGE SHORESIDE DISPOSAL OF PLASTIC TRASH

Commercial Fishermen

Commercial fishermen were asked which of seven techniques are the best ways to encourage commercial fishermen to return their plastic trash to shore for disposal. A summary of their responses is shown in Figure 3. Dockside disposal facilities and fines were the most frequent responses. There was some support for each of the techniques. Among the suggestions from the respondents were reminders on the marine radio channel, incorporation of information on proper garbage disposal into the licensing procedure, and use of advertisements and stickers.

Recreational Boaters

Figure 3 summarizes the responses of recreational boaters on which of seven techniques are the best ways to encourage recreational boaters to return their plastic trash to shore for disposal. Like the commercial fishermen, there was some support for each of the techniques, but dockside disposal facilities and fines were cited most often. The recreational boaters also suggested the following techniques: television advertisements and programs, educational material sent with license renewals, information broadcast on the marine weather channel, and peer pressure.

RESULTS

The results of this survey provide a baseline of knowledge on the garbage disposal practices of commercial fishermen and recreational boaters at four sites, and on their opinions and experiences with plastic marine debris. The results indicate that the problem of marine debris is not new to those responding to the survey. Further, the results show there are responsible commercial fishermen and recreational boaters. From the many comments written in the margins and on the backs of the survey form, it is also evident that many of the respondents think the source of marine debris is a group other than their own.

THE OREGON EXPERIENCE--FOUR YEARS LATER

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ABSTRACT

The fifth annual Oregon coastwide cleanup, held 10 October 1988, attracted 2,200 volunteers who collected 14.2 tons of debris. Similar fall cleanups were held in 22 coastal states of the United States, Costa Rica, and Puerto Rico. This paper reviews personal observations about the effectiveness of volunteer beach cleanups and discusses the evolution of data gathering, media coverage of the marine debris problem, changes in attitudes, and advancement in plastic recycling.

I am pleased to be here to share my knowledge on my favorite subject--"floatable trash." I became interested in this subject just 5 years ago. At the time, it was a challenge to find information on the subject at all. Let me tell you how I became involved.

In 1984, the May-June issue of the Alaska Fish and Game Department's magazine was delivered to my office by mistake. Flipping through it, I was drawn to an article by free-lance writer Tom Paul. Entitled "The plague of plastics," it discussed the proliferation of plastic debris in the natural environment and the resulting ingestion and entanglement by fish and wildlife.

At the time, I had worked at the Oregon Department of Fish and Wildlife for 10 years and been an active birdwatcher for 25 years. I knew birds got entangled in monofilament fishing line and six-pack beverage rings, but I didn't know they had an appetite for polystyrene foam and small bits of plastic.

In talking to birdwatchers, scientists, and friends, I realized others were also unaware of the problem. Since 1984 was the "Year of the Ocean" and we Oregonians love our coast, I had the idea to organize a cleanup of plastic debris on our 563 km (350 mi) of coast to see what we could find.

In R. S. Shomura and M. L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, 2-7 April 1989, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFSC-154. 1990.

I put together a small working group; we divided our coast into 14 zones and found people willing to serve as "zone captains." The captains were biologists from the Department of Fish and Wildlife and local residents of the coastal communities. Zone captains coordinate refreshments for celebration parties, assign volunteers to specific stretches of beach, arrange for the pickup of the collected debris, and work with the news media.

We spread the word of that first cleanup and invited the public to the coast to see how much marine debris we could collect on the 241 km (150 mi) of accessible beach.

Saturday, 13 October, was a very cold, wet, dark, blustery day. To my amazement, 2,100 volunteers showed up and collected 26.3 tons of debris in just 3 h. They filled out questionnaires documenting the quantity of fishing gear, six-pack yokes, polystyrene foam, plastic bags and bottles, rope, and strapping bands. We recorded the event on video film and produced a 12-min film entitled "Get the Drift."

Word of the cleanup spread quickly, and that November I was invited to report the results at the Workshop on the Fate and Impact of Marine Debris in Honolulu, Hawaii. Those attending were government scientists and concerned citizens from around the world working on marine mammal entanglement problems. I felt like an imposter with my citizen involvement project results, but the scientists welcomed me with open arms. They came up to me afterwards and thanked me for documenting the volume of trash in a large given area. Many had wanted to do beach surveys for years but were unable to spend time and money on that kind of research.

A number of recommendations came out of the workshop, and one was that beach cleanups are a valid way to document the amount and sources of marine debris. As a result, I was asked to organize and report on the findings of cleanups along the west coast and New England states in 1985.

I prepared the "Nuts and Bolts Guide to Organizing a Beach Cleanup the Easy Way." A "Dear Coastal Colleague" letter was mailed to over 200 organizations and government entities listed in the National Wildlife Federation Conservation Directory. They were asked to take an active part in organizing a cleanup in the study area states. Firm commitments were received from eight states.

State coordinators were mailed a copy of the Nuts and Bolts Guide as a "starter kit" but were encouraged to use special creativity to organize the cleanups. Some interesting logos, posters, and mottos resulted: "Lend a hand in the sand," "Don't be a litter boat," "Be a beach buddy," and "Debris-a-thon," to name a few. The main focus of the national cleanup was to determine the amount of derelict fishing gear, both sport and commercial, which makes its way to the coastal beaches, and to help educate the public.

Following the cleanups, I compiled the results in a report to the U.S. National Marine Fisheries Service.

The coastal cleanup program has grown by leaps and bounds. In 1986, we had 14 states participating. In 1987, there were 19 states. During September and October of 1988, all 22 coastal states, 7 inland states, and Costa Rica and Puerto Rico participated. All of the cleanups were held during Coastweeks, produced by a citizens' network of groups, agencies, and individuals who focus attention on that special place where water meets the land. During the period of Coastweeks, agencies and organizations in coastal states have beach walks, bird identification seminars, beach cleanups, and various activities to call attention to coastal issues. Five years ago it was simply Coastweek, but to accommodate the many states participating, with different weather and tide patterns, the annual campaign now stretches from the middle of September to the middle of October.

So after five cleanups, what are my thoughts about this whole business? I feel the number one value of beach cleanups is raising public awareness. Almost to a person the volunteers remark, "I never realized how much stuff was out there until I had to spend time leaning over to pick it up." And it sticks with them when they go back home. One friend told me that after working on a beach cleanup he couldn't enjoy playing golf because he kept seeing all the polystyrene cups in the ponds on the golf course. In areas where beach cleanups have occurred, government agencies responsible for monitoring trash containers indicate an increase in the amount of plastic debris which is disposed of properly.

Each year, our data gathering gets a little more sophisticated. As you might imagine, turning loose thousands of volunteers for 3 h with no "form-filling-out training" doesn't result in precise accounting of specific materials or number of pieces. But it does give an index of the type of debris and the probable source. The first 4 years we had a very general, short questionnaire. It gave us bulk figures, because volunteers would write "some," "many," "lots," "a few," under number of pieces. In 1988, we worked with the Center for Marine Conservation and used the questionnaire and guide which was used by approximately 43,000 volunteers nationally. The new questionnaire is more complex and specific. Prior to the cleanups, there was virtually no documentation on the amount or source of marine debris. So we have come a long way!

Our volunteers show up to work, are given a large collection bag, questionnaire, reminders about beach safety, and turned loose. Three hours later they come back laden with trash, enthusiasm, and stories of the weird things they found. We treat them to a free lunch to give them an opportunity to share their stories.

In years past, all of the debris from Oregon's cleanup went directly into landfills, thanks to the generosity of the Oregon Sanitary Service Institute. This year we introduced a "beach buddy" system. We asked volunteers to work in pairs and separate the plastic from other debris and place it in a special bag. After the cleanup, all the plastic and polystyrene foam was picked up by Environmental Pacific Corporation, taken to Portland, and analyzed to see how much of it could be recycled. We invited the press to watch us rip open the sacks, not knowing for sure what we would find. Much to my relief, all of it was plastic and most was

recyclable. On the minus side, I think we asked too much of the volunteers. It is not possible for one person to carry two sacks, a clipboard, writing tools, and also to pick up debris. So the system still needs refinement.

Many of our volunteers have participated in all five cleanups, and we are beginning to see more groups who charter buses for the trip from inland cities to the coast. Private industries sponsor employee trips, schools use the cleanup as an official school function, and civic groups organize carpooling and their own potluck picnics on the cleanup day.

Going after marine debris as "litter" on the beaches does not have the same public appeal as focusing on the issue of entanglement and ingestion by fish and wildlife. That focus has attracted the media and gotten new people interested and involved. I am sure everyone in this room knows the risk in getting people stirred up and emotionally involved. All of a sudden, the statistics you gather are used in very creative ways to prove a point on all sides of the marine debris and plastic recycling issues.

One of my earlier recommendations was to get a media blitz in the popular press, not just in obscure technical or professional journals. I am pleased to report there is hardly a week goes by that I don't run across a marine debris article in a commercial fishing industry magazine, conservation organization newsletter, or the newspaper. The state natural resource agency magazines and Sea Grant publications have also done an excellent job to further document the problem through feature articles complete with color photographs of injured wildlife.

I hope this trend continues. There should be repeated articles in newspapers, not just in the outdoor section but in business and science. Even the special newspaper supplements available to tourists along the coast should have articles on marine debris. The amount of trash on beaches has an adverse economic impact for coastal communities and states competing for tourism dollars. That fact was brought home to us in 1988 with the hospital waste showing up on New York and New Jersey beaches.

The publications which have not picked up on the severity of marine debris are those targeted for the sport fishing and recreational boating public. Because of the way licenses and permits are issued, recreationists have been missed by traditional Federal agency notices. We have found a larger percentage of bait containers and recreational gear during our cleanup since commercial vessel owners are better informed. For instance, I don't think the recreational fleet knows about the adoption of Annex V to the International Convention for the Prevention of Pollution from Ships (MARPOL).

A major value of the cleanups is networking with people in coastal states working on marine debris. The networking provides a vehicle to communicate findings and the status of state and Federal legislation; compare how the cleanups are organized; and share artwork, slogans and campaign strategies, what works with the media, and how to get donated materials or funding. Having the cleanups clustered during 1 month in the fall gives everyone higher visibility with the public and news media.

Now that we have the new questionnaire, we can get a better handle on how to identify items that cause the majority of entanglement or ingestion problems and focus our efforts on their source.

One of the most exciting things to come along is the pilot project conducted by the Port of Newport here in Oregon. They set up a recycling program for commercial fishermen and other marine users to separate their trash at the dock. They gave the wood to senior citizens and sold the scrap paper, glass, and metal, and only a small portion was left over for the landfill. The net fragments were recycled by tourists wanting decorations for their patios or local citizens needing supports for their vegetables or backstops for their softball fields. That 1-year program gained support and energy from a small commercial fishing community which has radiated enthusiasm and interest to the entire Pacific Rim fishing industry. Its coordinator, Fran Recht, has a new grant to implement similar projects in Alaska, California, Oregon, and Washington this year and continue educational programs with the commercial fishing industry and port officials. As long as ocean users continue to dump trash overboard, beach cleanups have a transitory value in ridding the beaches of debris. The Newport project has directly reduced the amount of debris on Oregon's central coast.

The adoption of Annex V to MARPOL has provided strong incentives for improved port facilities and less dumping at sea. I suspect it will foster accelerated plastic recycling programs.

In Oregon we have good news. On 8 October 1988, we attracted 2,200 volunteers. But they were only able to collect 14.2 tons compared to the 26.3 tons in 1984. Each year we have seen a steady decline in the amount collected, and there are several contributing factors. Our weather has been mild each fall with no major storms depositing new trash before the cleanup. Luck of the currents, no doubt. Also, the Oregon State Parks Department has held a "Company's Coming" cleanup in the spring for the past 3 years, so we didn't have an entire year's accumulation. As a general rule, beach users are carrying out their own trash and debris they see washed on shore, and on Oregon's central coast, adjacent to the Port of Newport pilot project, there was simply less debris available. The increased public awareness through the cleanups has made a big difference in Oregon.

As an extension to the regularly scheduled cleanups, we launched an "adopt-a-beach" program patterned after the State of Texas, inviting Oregonians to choose a section of the Oregon coast they want to "adopt." All we ask is that they clean it three times a year and tell us what they find.

I am really pleased to visit with you and share my enthusiam about how one person's idea can make a change. Since being involved in cleaning beaches, I am better informed about entanglement and ingestion by wildlife, environmental monitoring using citizen volunteers, how plastic is made and recycled, and best of all how valuable trash can be.

Thank you.

THE TEXAS ADOPT-A-BEACH PROGRAM: A PUBLIC/PRIVATE APPROACH TO CLEAN BEACHES

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ABSTRACT

The Texas Adopt-A-Beach Program, founded in 1986 by Texas Land Commissioner Garry Mauro, is made up of private citizens who volunteer to clean Texas beaches three times a year, and is managed by the Texas General Land Office. The program was conceived both as a short-term solution to the problem of trash on Texas beaches and as a means of advancing long-term, permanent solutions to the problem of marine debris: the ratification of Annex V of MARPOL, the International Convention for the Prevention of Pollution from Ships, and the implementation of effective enforcement measures.

The Adopt-A-Beach Program organizes two coastwide beach cleanups a year. The success of these cleanups--nearly 25,000 volunteers have removed 1,000 tons of garbage from Texas beaches--has enabled the program to shift its emphasis to public education about the tremendous economic and environmental damage caused by ocean dumping of garbage. Children are the focus of educational projects that include a coloring book and puppet show featuring the program's mascot, Lucky the Dolphin, and the development of a marine debris curriculum for public schools. The program has also produced videotaped public service announcements for statewide broadcast and has sponsored special awareness events in conjunction with cleanups.

Data collected by volunteers during cleanups were instrumental in building support in Congress for Senate ratification of the international MARPOL Annex V and implementation legislation for the annex in the United States. Annex V prohibits the dumping of plastics in the ocean and sets strict limits on dumping of other solid wastes overboard. The volunteer-collected data are also being used in support of making the Gulf of Mexico a special area under the annex. Dumping of any kind is prohibited in special area waters.

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INTRODUCTION

Texas Land Commissioner Garry Mauro founded the Texas Adopt-A-Beach Program in 1986 after taking part in a coastwide beach cleanup organized by the Center for Environmental Education (now the Center for Marine Conservation). In the course of this 3-h event, 2,700 volunteers collected 124 tons of trash from 196 km (122 mi) of beach. It was clear that this volume of trash could not be attributed to beach littering alone; the quantity and the nature of the debris indicated that most of it had washed ashore in tides of waterborne refuse.

Astonished at the quantity of trash on Texas beaches, and recognizing the heavy environmental and economic penalties of this pollution, Commissioner Mauro decided to investigate the problem and determine what role the General Land Office could play in solving it. He began by forming an in-house task force to study the sources of beach debris, to research existing legal and institutional remedies, and to map out an action plan.

Both a 1985 Texas Coastal and Marine Council report and the Center for Environmental Education's report on the 1986 beach cleanup concluded that some 75 to 90% of the trash on Texas beaches originates offshore, about two-thirds of it dumped from ships. Refuse discarded in the Gulf of Mexico is not washed out to sea. What fails to sink is held in gulf waters by loop currents until oblique alongshore currents carry it to shore. For this reason, the beach cleaning efforts of cities and counties along the Texas coast have provided only temporary relief, and at great cost: the State's coastal communities spend about $14 million each year on the endless task of cleaning their beaches.

The Texas Approach

Two needs were immediately apparent: the need to raise public awareness of the magnitude of the beach garbage problem in Texas, and the need for a broad-based, unified approach to its solution, concentrating on the sources of beach debris.

An obvious objective was to work for U.S. ratification of Annex V to MARPOL 73/78 to prohibit ocean dumping of plastic and restrict the discharge of other types of solid waste at sea. The severity of the beach pollution problem in Texas led to a second: to persuade the International Maritime Organization to designate the Wider Caribbean Region (the Gulf of Mexico and the Caribbean Sea) as a special area where virtually all dumping would be banned. But the General Land Office began with state-level action that would yield positive results more quickly.

As manager of the state's surface and mineral interests in about 1.62 million ha (4 million acres) of submerged land on the Texas gulf coast, the General Land Office issues leases, easements, and permits for a variety of activities. The agency's first step was to adopt emergency rules prohibiting the dumping of solid waste from offshore platforms and seismic vessels operating in Texas waters under state permits. These were later followed by no-dumping rules (and parallel contract provisions) for marinas, wharves, piers, fishing cabins, and all other structures on state-owned coastal land.

Next, to draw public attention to the amount of trash and garbage accumulating on Texas beaches, to augment existing beach cleanup efforts, and to involve citizens in the crusade against marine debris, the General Land Office instituted the Texas Adopt-A-Beach Program.

The program was modeled after the Adopt-A-Highway Program organized by the Texas Department of Highways and Public Transportation. The Adopt-A-Highway Program has proven highly successful both as a cleanup program and as a public awareness campaign to discourage roadside littering. It was felt that the adoption format, already familiar to Texans, would work equally well for the state's beaches. The Highway Department's slogan, "Don't Mess with Texas," was expanded to "Don't Mess With Texas Beaches" for the beach cleanup campaign.

Response to the Program

The Adopt-A-Beach Program won immediate enthusiastic support in Texas. Adopters were secured for all 172 easily accessible Texas beach miles within the first year of the program, and even some segments accessible only by boat or four-wheel-drive vehicle found sponsors. Most adopting groups have renewed their adoption agreements annually. Businesses, philanthropic foundations, entertainers, advertisers, and private citizens have made generous contributions of funding, supplies, services, and promotional assistance.

Since the program's first coastwide cleanup in April 1987, nearly 25,000 volunteers have removed more than 1,000 tons of trash from Texas beaches. An analysis of data collected during coastwide cleanups, prepared by the (then) Center for Environmental Education, was presented to the U.S. Congress and to the International Maritime Organization as evidence documenting the need for U.S. ratification of MARPOL Annex V, the passage of national enforcement legislation, and designation of the Wider Caribbean Region as a special area under the annex.

The spirit of the Adopt-A-Beach Program has spread beyond state boundaries and beyond U.S. borders. The Texas program has been emulated by other coastal states, and it is now spreading to Central America. In September 1988, Texas, Louisiana, Mississippi, Alabama, and Florida joined forces in a "Take Pride Gulfwide" beach cleanup sponsored by the U.S. Minerals Management Service. A symbolic beach adoption agreement entered into by the students of Flour Bluff Junior High School near Corpus Christi, Texas, and the children of Costa Rica in the spring of 1988 immediately led to the establishment of a national Costa Rican beach cleanup program.

PROGRAM STRUCTURE AND OPERATION

The Adopt-A-Beach Program takes its direction from State Government, but it is operated at the county level by an all-volunteer work force and is dependent upon private funding and in-kind donations of supplies and services.

An Adopt-A-Beach Task Force appointed by Commissioner Mauro developed guidelines for the program and oversees its operations. This advisory

body, whose members now number about 55, represents a broad range of coastal interests: Federal, state, and local government; oil, gas, and chemical production; tourism; shipping; agriculture; waste disposal and recycling; scientific research; and conservation. The task force meets periodically in full session for program review and planning. Three subcommittees--Finance, Education, and Legislation--hold independent meetings.

The General Land Office, as administrator of the Adopt-A-Beach Program, coordinates all program activities with the assistance of the Adopt-A-Beach task force. It oversees beach adoptions, promotes the program statewide, solicits funding, organizes two annual coastwide cleanups, and develops educational materials and programs. The agency also maintains a toll-free number for in-state inquiries about the program and publishes a quarterly newsletter, the Texas Beach Bulletin,

The Texas Conservation Foundation, a state agency empowered to manage and expend donated funds, is financial trustee for the Adopt-A-Beach Program. It manages a special fund established to receive tax-deductible contributions for the support of program activities. Monies from the fund are used for:

- the purchase and shipment of cleanup supplies, including trash bags, data cards, and pencils;
- the purchase and installation of beach signs marking adopted beach segments and crediting adopting groups;
- printing and mailing of the program's newsletter, certificates, posters, brochures, and other promotional and educational materials;
- operation of the program's toll-free telephone line; and
- promotional events to publicize the program and to recruit sponsors and cleanup volunteers.

A network of volunteer county coordinators provides grassroots leadership for the program. They recruit and register adopting groups, handle local cleanup logistics, and promote the program within their communities. This structure is not only practical, but also capitalizes on community pride--a powerful force in sustaining the program's momentum.

To join the program, groups sign an adoption agreement that commits them to cleaning a designated beach segment (usually 1.6 km (1 mi)) three times within a 1-year period, participating in the program's two coastwide cleanups and conducting a third cleanup independently. The agreement also releases the Adopt-A-Beach Program from liability for any injury incurred during a beach cleanup. Each adopting group receives an adoption certificate, and the group's name is listed on a sign installed at the access road nearest its adopted beach segment.

Groups now enrolled in the program include civic clubs, sporting clubs, chambers of commerce, large corporations, small businesses, conservation organizations, public schools, colleges, Scout troops, state agencies, cities, property owners' associations, and families.

The program's two annual coastwide cleanups are cosponsored by nonprofit organizations. The "Great Texas Beach Trash-Off," held in April of each year, is cosponsored by Keep Texas Beautiful, Inc. The "Texas Coastal Cleanup," held in September during Coastweeks, is cosponsored by the Center for Marine Conservation. Participants in these cleanups include independent volunteers as well as affiliates of the Adopt-A-Beach Program. Local coordinators distribute trash bags, data cards, and pencils to all cleanup volunteers.

The data cards provide spaces for the tabulation of items within seven broad categories (plastic, glass, Styrofoam, metal, paper, wood, and rubber), for the notation of labels that might indicate the sources of items collected, for recording the number of trash bags filled, and for reporting sightings of stranded or entangled animals.

PROGRAM PROMOTION

The Adopt-A-Beach Program employs a variety of means to publicize the adoption program, advertise coastwide cleanups, and recruit volunteers and sponsors. The program carries its promotional efforts statewide to remind noncoastal Texans that they are residents of a coastal state, that they benefit from the coastal area both directly and indirectly, and that they should share the responsibility for protection of coastal waters and beaches.

Recruitment

When the program was first organized, the General Land Office recruited county coordinators through telephone calls, letters, and personal visits to community leaders and known environmentalists along the coast. The same procedures were used by the General Land Office Adopt-A-Beach staff and county coordinators to enlist adopters. Lists of prospective adopters were compiled from target groups such as garden clubs, 4-H clubs, local branches of oil and gas companies, and waste disposal companies.

Early recruitment was greatly facilitated by television and newspaper coverage of press conferences preceding the program's first coastwide beach cleanup in the spring of 1987 and by establishment of the program's toll-free telephone number (1-800-85-BEACH). Now that the program is well known, it has become less necessary to engage in aggressive recruitment of participants. New county coordinators, new adopting groups, and sponsors often initiate contact with the program.

Solicitation of Financial and In-Kind Support

All public information materials produced by the Adopt-A-Beach Program emphasize that the program is dependent upon private donations for its

operation and that such donations are tax-deductible. The program solicits contributions of money, supplies, or services through direct appeals to companies that have a reputation for supporting environmental causes or that are likely to appreciate the benefits of association with an environmental improvement program. It has also sought grants from foundations known to support conservation efforts.

Financial donations to the Adopt-A-Beach Program have included a 3-year grant of $50,000 from the Moody Foundation of Galveston, a $5,000 grant from the Fondren Foundation of Houston, and a contribution of $10,500 from Browning-Ferris Industries, a waste disposal company. Other contributions have come from oil and gas companies, law firms, and numerous private individuals.

In-kind donations to the program have included bumper stickers, trash bags, celebrity promotions, refreshments for cleanup participants, and pickup of filled trash bags after beach cleanups. The Mobil Corporation donated 100,000 garbage bags valued at $13,000 to the program in 1988, and Maryland Club Foods donated 9,700 bags for the 1989 Great Texas Beach Trash-Off. One of the first in-kind donations to the program was 15,000 "Don't Mess With Texas Beaches" bumper stickers, provided by a beer distributor.

In 1988, 23 outdoor advertising companies donated space along major routes to the coast for 300 billboards displaying the "Don't Mess With Texas Beaches" slogan and the program's toll-free number. Most of the billboards were printed with money from the Adopt-A-Beach fund and posted by companies that donated the advertising space, but some companies painted billboards free-of-charge.

Media Coverage

The Texas Adopt-A-Beach Program has benefited from both local and national media attention. After the April 1987 coastwide cleanup, articles appeared in the New York Times and the Los Angeles Times, and both Time and Newsweek magazines featured articles about the status of beaches in America as front-cover stories. In August 1987, Commissioner Mauro discussed the problem of beach trash in Texas as a guest on the ABC television news program Good Morning, America.

Press coverage of program activities is invaluable in advertising the program, mustering volunteers for coastwide cleanups, and publicizing cleanup results. Press releases are issued to newspapers, radio stations, and television stations in advance of cleanups and as soon as statistics on the number of volunteers participating and the tons of trash collected are available afterward.

The adoption of a mascot, an Atlantic bottlenose dolphin named Lucky, enlivened the Adopt-A-Beach Program's promotional campaign and gave the program a symbol with appeal for children. Lucky, a performer at Sea-Arama Marineworld in Galveston, Texas, is an especially appropriate mascot for the program because he was a victim of marine debris, barely surviving

entanglement in an abandoned fishing net. He was given his fitting name by the veterinarians of the Marine Mammal Stranding Network who nursed him back to health.

Public service announcements are produced for radio and television broadcast before every coastwide beach cleanup. The program's first videotaped public service announcement featured Lucky and Texas rock musician Joe "King" Carrasco. The second video, featuring actor Randy Quaid, was produced to advertise the 1989 Great Texas Beach Trash-Off. A third was produced to publicize the MARPOL Annex V regulations. All public service announcements are distributed statewide.

Printed Materials

The program produces brochures and posters to advertise coastwide cleanups. These are sent to county coordinators, adopting groups, coastal chambers of commerce, public libraries, hotels and motels, and other businesses for distribution. Cleanup brochures list the names and telephone numbers of county coordinators, the locations of designated beach check-in points for volunteers, and the names of hotels and motels offering discounts to cleanup workers.

The quarterly Texas Beach Bulletin, with a current circulation of about 3,300, summarizes Adopt-A-Beach Program activities, announces cleanup dates, reports results of coastwide cleanups, and acknowledges donations to the program. It serves as an educational as well as a promotional tool, containing articles about national and international efforts to combat marine debris. The newsletter is sent to Adopt-A-Beach Program participants and supporters and is included in the information packet mailed to anyone who calls or writes to inquire about the program.

PUBLIC EDUCATION

With the beach cleanup program well established in all coastal counties, the Adopt-A-Beach Program is concentrating on public education projects, including educational materials and programs for children, an awareness drive targeting recreational boaters, and a campaign to promote recycling. An important element of all these efforts is publicizing the requirements and expected results of MARPOL Annex V.

Outreach to Children

Children are the primary target of educational efforts. In the summer of 1988, the Adopt-A-Beach Program introduced an educational program for preschool and primary-grade children. Its components are a slide show, a puppet show, and a "Don't Mess With Texas Beaches" coloring book.

The slide show contrasts clean and littered beaches, shows how trash reaches the beach and how it can harm birds and marine animals, and tells the story of Lucky the Dolphin. In the puppet show, called "Joey Saves the Day," a boy fishing from a boat rescues Lucky and his friend Clipper the Crab from the Trash Monster. In the 11-page coloring book, Lucky points

out the hazards of beach litter and floating trash and urges children to help keep beaches clean. Simple lyrics for a series of beach cleanup songs set to familiar tunes are printed in the back of the book.

The educational program has been presented to an estimated 4,000 children at day-care centers, public libraries, museums, and elementary schools in Austin and coastal cities and has proven very effective in interesting children in the cause of beach protection. Because the puppet show has been so well received by teachers, librarians, and children, it is being videotaped for distribution throughout the state. Coloring books have been given to all children attending the program, and at least 20,000 more have been distributed by mail. Five hundred Spanish-language versions of the coloring book were sent to children in Costa Rica.

The Adopt-A-Beach Program is now working on a formal marine debris curriculum for kindergartens and elementary schools. It will include lessons about the nature and importance of marine and coastal resources; the damage caused by marine debris, particularly plastics; and recycling as a solution to the problem of solid waste in the environment.

The program staff is preparing a curriculum outline in consultation with the Education Subcommittee of the Adopt-A-Beach Task Force. To ensure that the curriculum meets state requirements for public school use, the staff is also coordinating development of the project with the Texas Education Agency. It is anticipated that the actual writing of the curriculum will be contracted to an educational consultant.

Promoting Awareness Among Recreational Boaters

The Adopt-A-Beach Program is working with the Boating Trades Association of Texas and the Marina Association of Texas to make boaters aware of the need for their cooperation in the battle against marine debris. The program's first public service video was directed at recreational fishermen and boaters, urging them not to discard trash overboard. The Boating Trades Association and the Marina Association have distributed "Stow It--Don't Throw It" bumper stickers that include the Adopt-A-Beach Program and Center for Environmental Education logos.

Recycling Campaign

The Adopt-A-Beach Program is broadening its mission by promoting recycling as a practical means to reduce solid waste in the environment and alleviate the burden on landfills. The focus of the recycling campaign is plastic, which makes up some 60% of the trash collected in coastwide beach cleanups.

General Land Office staff helped draft container-coding legislation for introduction in the 1989 session of the Texas Legislature. Information about the proposed law, which would require coding of plastic containers by resin type to facilitate recycling, has been published in the program's newsletter.

In conjunction with the April 1988 coastwide cleanup, the Society for the Plastics Industry sponsored a plastics recycling demonstration for cleanup volunteers at South Padre Island. In September 1988, Shell Oil Company sponsored a "Trash Bash" for volunteers who brought glass, paper, aluminum, and plastic to Sea-Arama Marineworld in Galveston for pickup by recycling companies.

To further encourage beach cleanup volunteers to become recyclers, and to take advantage of the opportunity to recycle large amounts of beach debris, participants in the 1989 Great Texas Beach Trash-Off were asked to separate the trash they picked up from the beach, putting recyclable materials into orange bags, and nonrecyclable trash into white bags. Keep Texas Beautiful, Inc., cosponsor of the cleanup, made arrangements for collection of the recyclable trash by local companies.

In conjunction with the 1 April 1989 Great Texas Beach Trash-Off, the Texas Arts Council and Business Volunteers for the Arts/Houston joined the Adopt-A-Beach Program in sponsoring a juried beach trash sculpture contest in Galveston. The contest was conceived as a means of publicizing the sources and types of debris found on Texas beaches, drawing attention to the program's cleanup and recycling campaigns, and adding the arts community to interests endorsing the beach cleanup program.

A brochure containing contest guidelines and an entry form was distributed to members of the Texas Arts Council and to artists on a mailing list supplied by the Texas Commission for the Arts. Posters advertising the contest, called "Trash for Art's Sake," were sent to art museums and galleries. Cash prizes were awarded to the top three winners, and other contestants received honorable mention. Ten prize-winning entries will tour art museums throughout the state before being donated to coastal museums for permanent display.

FUTURE OF THE PROGRAM

Special Area Designation

Data collected by Texas volunteers in future beach cleanups will permit evaluation of the effectiveness of MARPOL Annex V regulations in reducing the amount of plastic and other floating debris reaching Texas shores. The data will also support the Texas Adopt-A-Beach Program's ongoing effort to secure special area designation for the Wider Caribbean Region under the annex.

The Adopt-A-Beach Program will continue to encourage the establishment of parallel beach cleanup programs throughout the Caribbean region. The success of the Costa Rican beach cleanup program has inspired both Panama and Honduras to establish similar programs, and it is hoped that other countries will follow suit. The demonstration of widespread, serious concern about marine debris in the Wider Caribbean should benefit the cause of special area designation.

Continuing Educational and Awareness Projects

The program will continue to stress the importance of recycling as a solution to the solid waste problem and will work to promote the expansion of recycling efforts throughout the state. The Adopt-A-Beach staff is cooperating with the Bryan and College Station, Texas, independent school district in a program that will combine classroom education with an active recycling project for public school students next year.

An expanded awareness campaign will be undertaken to educate recreational boaters about the hazards of marine debris, to inform them about MARPOL Annex V regulations, and to encourage all marinas on the Texas coast to provide garbage reception facilities like those the General Land Office now requires for marinas on state-owned land. The Adopt-A-Beach Program will supply boaters with garbage bags and award certificates of appreciation to volunteers who pledge to participate in an aquatic version of the beach cleanup program.

Research and Planning

The Adopt-A-Beach Program is helping Texas ports prepare to contend with the plastic refuse that will be off-loaded by ships in accordance with MARPOL Annex V regulations. The program is helping the ports locate researchers, waste management companies, and recycling companies that can supply needed planning assistance, equipment, and services.

The Adopt-A-Beach Program is also represented on the Marine Debris Technical Subcommittee of the U.S. Environmental Protection Agency's Gulf of Mexico Program, assisting with data collection, data analysis, and exploration of methods to alleviate both marine and beach debris throughout the gulf region.

Addressing Land-Based Sources of Beach Debris

The reduction--and, it is hoped, eventual elimination--of marine debris in the Gulf of Mexico will not entirely solve the problem of solid waste pollution of Texas beaches. Though offshore sources are to be blamed for most of the trash fouling the state's shoreline and nearshore waters, land-based sources make a substantial contribution. For this reason, the utility of the Adopt-A-Beach Program will not soon be diminished.

Land-based sources--onshore dumping, river-transported trash, and persistent littering--will be the target of future Adopt-A-Beach Program awareness efforts. Data collected by beach cleanup volunteers can provide estimates of the amount of beach trash attributable to these sources and can help to identify chief offenders.

CONCLUSION

The rapid success of the Adopt-A-Beach Program in establishing a strong alliance between government and the private sector in the crusade against marine debris, in stirring citizen activism both within and beyond

Texas, and in becoming a catalyst for the statewide expansion of solid waste control efforts exceeded 1986 expectations. The program's influence can be largely attributed to timing: it was inaugurated at a time when Americans had at last begun to realize that pollution of coastal waters and shorelines had reached a critical stage.

But it cannot be assumed that no one among the volunteers who rallied to the cry "Don't Mess With Texas Beaches" would have been willing to participate in a coastal cleanup effort years earlier. In fact, many program volunteers were already participants in, or supporters of, other conservation efforts. Those who were not may just have been waiting for direction.

The Adopt-A-Beach Program provided that direction. It has succeeded because it offers an easy avenue for citizen participation, enabling citizens from all walks of life to make an important contribution to the coastal cleanup effort. Those who cannot provide hands-on assistance at the beach can support the program by donating money, supplies, or services. Those who can offer neither physical nor financial support for program activities can be of equal help by simply spreading the word--by helping to heighten public awareness of the environmental and economic costs of marine debris. The program's design has facilitated development of the broad base of informed support essential to genuine progress against so widespread and complex a problem.

MARINE DEBRIS DEMONSTRATION AND EDUCATION PROJECT AT SQUALICUM HARBOR, BELLINGHAM, WASHINGTON, U.S.A.

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ABSTRACT

Washington Sea Grant's North Puget Sound Office in Bellingham, Washington, began a demonstration and education project about marine debris in January 1988. The objectives of this project were:

1. to develop a demonstration project to collect and recycle vessel-generated wastes from commercial and recreational vessels at Squalicum Harbor, Bellingham, Washington; and

2. to develop an educational program to teach commercial fishermen and boaters about marine debris through a variety of extension education techniques.

Squalicum Harbor provides moorage for about 1,750 boats, of which 1,050 are recreational and 700 are commercial. The commercial fishing fleet is composed mostly of gillnetters (7.6-10.8 m long) and purse seiners (15.3-18.4 m long) that fish in Puget Sound and Alaska. The recreational fleet has about equal numbers of sail and powerboats, and 75-100 boats are used as live-aboard homes.

The demonstration project was coordinated with the Port of Bellingham, which owns and manages Squalicum Harbor. The function of Washington Sea Grant staff in this project was to act as technical advisors to the port staff. They surveyed the boaters, analyzed waste collection facilities and alternatives, and offered suggestions on improvements that could be accomplished in a cost-effective and realistic manner. The educational program focused on using traditional extension education techniques. A poster and three publications on marine debris were developed. These materials were important components of the extension education portion of this project. Because of the time it has taken to implement the changes proposed in the demonstration project, no measurements of their effects have yet been made.

In R. S. Shomura and M. L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, 2-7 April 1989, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFSC-154. 1990.

INTRODUCTION

For years, people aboard boats and in coastal areas threw their garbage into the water. Items such as tin cans, food waste, cardboard, and cotton fishing gear and lines quickly sank. These materials generally degraded and caused relatively few problems in the marine environment. Also, as a rule marinas had dumpsters or litter barrels near the docks for garbage disposal, but no specialized waste collection systems.

Today, however, much of the material that is thrown overboard or lost in Puget Sound and in the oceans is made of plastic. Plastics are very useful aboard vessels because they are lightweight, strong, and do not degrade when wet. However, these same qualities can cause problems when plastics are disposed of in the marine environment. Studies from many parts of the world have shown that serious problems result when wildlife encounters plastic marine debris (Shomura and Yoshida 1985; Center for Environmental Education 1987; Alaska Sea Grant 1988; Alverson and June 1988).

As more U.S. and worldwide attention focused on plastic marine debris, Annex V of the MARPOL Convention was ratified internationally in 1987, and to implement that convention in the United States, Congress passed the Marine Plastic Pollution Research and Control Act (MPPRCA) in 1987. The MPPRCA, which became effective on 31 December 1988, prohibits the dumping of plastics at sea and regulates the dumping of other wastes at sea (U.S. Department of Transportation 1988). With the implementation of MPPRCA, boaters and fishermen now must return boat wastes to port, and ports and marinas must have facilities to accept those wastes.

Within Puget Sound, the volume and sources of marine plastic debris and the problems it causes are not well known. Because of Washington's extensive recreational and commercial fishing fleets, one would expect to find debris common to those vessels and activities. Some negative impacts of derelict fishing gear within Puget Sound have been observed (High 1985), but the extent of the problem is unknown.

Despite a lack of specific data about the extent of the marine debris problem within the Puget Sound region, it was felt that marine plastic debris was causing problems in the area. Also, as a result of MPPRCA, boaters were prohibited from disposing of their wastes into Puget Sound, and marinas were mandated to have facilities to accept boat garbage. In general, however, few boaters, fishermen, or marina operators were familiar with the MPPRCA and its provisions. The Squalicum Harbor project was developed with two primary goals:

1. to develop a pilot project to collect and recycle vessel-generated wastes from commercial and recreational vessels at Squalicum Harbor, and

2. to develop an educational program to teach commercial fishermen and boaters in the Puget Sound region about marine plastic debris and its proper disposal.

The Port of Newport (PON), Oregon, had developed a pilot marine debris collection and education project that was fairly successful. With grant funding from the U.S. National Marine Fisheries Service, the Newport project was able to develop a successful waste collection system that was used by the commercial fishing fleet for nets, rope, wood, metal, and other materials (Recht 1988).

The Squalicum Harbor project hoped to build on the experiences of the Newport project. However, four major differences between the projects were evident. First, the PON project was organized as a staff project of the PON. The Squalicum Harbor project was being developed by people outside the Port of Bellingham staff. Second, the PON project provided funding for facilities and maintenance staff, whereas the Squalicum Harbor project did not. (For the project to be successful in the long run, it had to work within the operational budget of Squalicum Harbor.) Third, the types of debris at the harbors were different. In each harbor, the debris reflected the boats that use the marinas: Newport has more trawlers, and Squalicum has more purse seiners, gillnetters, and recreational boats. Fourth, the physical layouts of the harbors are different: Newport has separate marinas for the commercial and recreational fleets, whereas Squalicum Harbor has these fleets within the same marina.

METHODS

Squalicum Harbor is located some 144.8 km (90 mi) north of Seattle on Bellingham Bay. It provides moorage for about 1,750 boats, of which 1,050 are recreational and 700 are commercial. The commercial fishing fleet is composed mostly of gillnetters (7.6-10.8 m long) and purse seiners (15.3-18.4 m long) that fish in Puget Sound and Alaska. The recreational fleet has about equal numbers of sail and powerboats, and 75-100 boats are used as live-aboard homes. Squalicum Harbor has three water entrances and nine ramps to the docks.

Existing waste-handlng and collection facilities and procedures were analyzed using: 1) a personal informal interview survey of boaters and fishermen who use the harbor; 2) discussions with Squalicum Harbor staff; 3) a visual survey of the waste-handling facilities; and 4) contacts with waste collection companies, recycling companies, and community agencies.

Educational materials were developed and written by Washington Sea Grant (WSG) staff working on the marine debris project. Original plans called for writing one extension education publication for each of four different audiences: Squalicum Harbor boaters and fishermen, commercial fishermen, recreational boaters, and marina operators. Additionally a poster, a slide show, and a display area were to be developed.

DISCUSSION

Squalicum Harbor Analysis and Proposal

Twenty-seven fishermen and boaters from Squalicum Harbor were interviewed during spring 1987. Tabulation of the respondents' answers

showed that 78% thought Bellingham had a marine debris problem, 52% had experienced problems such as fouled propellers or clogged water intakes caused by plastic debris, 74% indicated that the existing waste facilities at Squalicum Harbor were adequate, and 67% expressed a willingness to sort some of their wastes for a recycling program. Respondents also indicated that management of an oil recycling facility maintained for boaters' use needed improvement.

Squalicum Harbor provided one 4.58 m^3 (6 yd^3) dumpster at the top of each float ramp, additional dumpsters in the area where commercial fishermen work on their gear, and a 15.29 m^3 (20 yd^3) dumpster near the dock used for provisioning vessels.

The visual survey of dumpster contents and interviews with Squalicum Harbor staff showed that the composition of the garbage varied with the season and the type of harbor use near that dumpster. For example, the percentage, by volume, of cardboard boxes ranged from 5 to 100%, with a mean of 52%.

Squalicum Harbor had a contract with the local garbage disposal company to empty the dumpster at the harbor. Seasonal fluctuations in quantity and composition of garbage were reflected in different pickup schedules for different dumpsters (Table 1). Rates varied with the frequency of pickup, the size of the dumpster, and whether the garbage went to landfill or to incineration (Table 2). The cost of garbage service at Squalicum Harbor rose dramatically from 1983 to 1987 (Table 3). This increase was caused by marina growth, boater population growth, and increases in garbage pickup rates over the time period.

On analysis, Squalicum Harbor's waste-handling facilities were judged to be adequate. Increased volumes of waste materials generated because of heightened awareness of the facilities could be easily accommodated by increasing the frequency of dumpster pickup. Any attendant cost increases could be minimized by developing a collection and recycling system for cardboard and aluminum. As in the PON project, a significant volume of the wastes in dumpsters at Squalicum Harbor was cardboard.

With this analysis completed, a proposal was written and presented to the Squalicum Harbor staff in August 1988. This proposal provided a detailed plan to improve the waste-handling system at Squalicum Harbor. The major elements of the plan were to maintain all existing dumpsters in the harbor; provide collection boxes or cleared space for netting, cardboard, scrap metal, wood, and aluminum; organize free pickup of materials by local recycling companies; and advertise the program through signs, pamphlets, news articles, presentations, displays, and word of mouth.

Figure 1 locates the proposed waste collection facilities at Squalicum Harbor. These facilities would:

- Provide a central location at the harbor for recycling scrap metal, wood, and netting. This would be a cleared space with signs indicating where to stack different materials.

Table 1.--Frequency of dumpster pickup at Squalicum Harbor.

Season	Size of container	Frequency of pickup
Winter (Oct.-May)	4.58 m^3 (6 yd^3)	1 per week
Winter	15.29 m^3 (20 yd^3)	1 per month
Winter	15.29 m^3 (20 yd^3) (trash compactor)	1 per month
Summer	4.58 m^3 (6 yd^3)	3 per week
Summer	15.29 m^3 (20 yd^3)	On-call basis
Summer	15.29 m^3 (20 yd^3) (trash compactor)	On-call basis

Table 2.--Monthly rates for hauling and disposal of trash from Squalicum Harbor.

Dumpster size	Frequency of pickup		
	1 per week	2 per week	3 per week
4.58 m^3 (6 yd^3)	149.27	276.15	403.03
15.29 m^3 (20 yd^3)	[a]130.75	[a]205.11	[a]279.47
15.29 m^3 (20 yd^3) (trash compactor)	[a]107.20	[a]214.40	[a]321.60

[a]Additional charges for hauling and disposal fee.

Table 3.--Total costs of garbage service in Squalicum Harbor.

Year	Cost
1983	$18,794
1984	$22,394
1985	$30,456
1986	$34,492
1987	$41,758
1988	$50,000 (estimated)

- Provide collection boxes for sorting and recycling of cardboard at five of the nine dumpsters at the harbor, dumpsters used primarily by the commercial fishing fleet. Used wooden fish totes were donated by local seafood companies for collection boxes. Removing the cardboard was expected to reduce the rate at which the dumpsters filled up and thus reduce garbage costs.

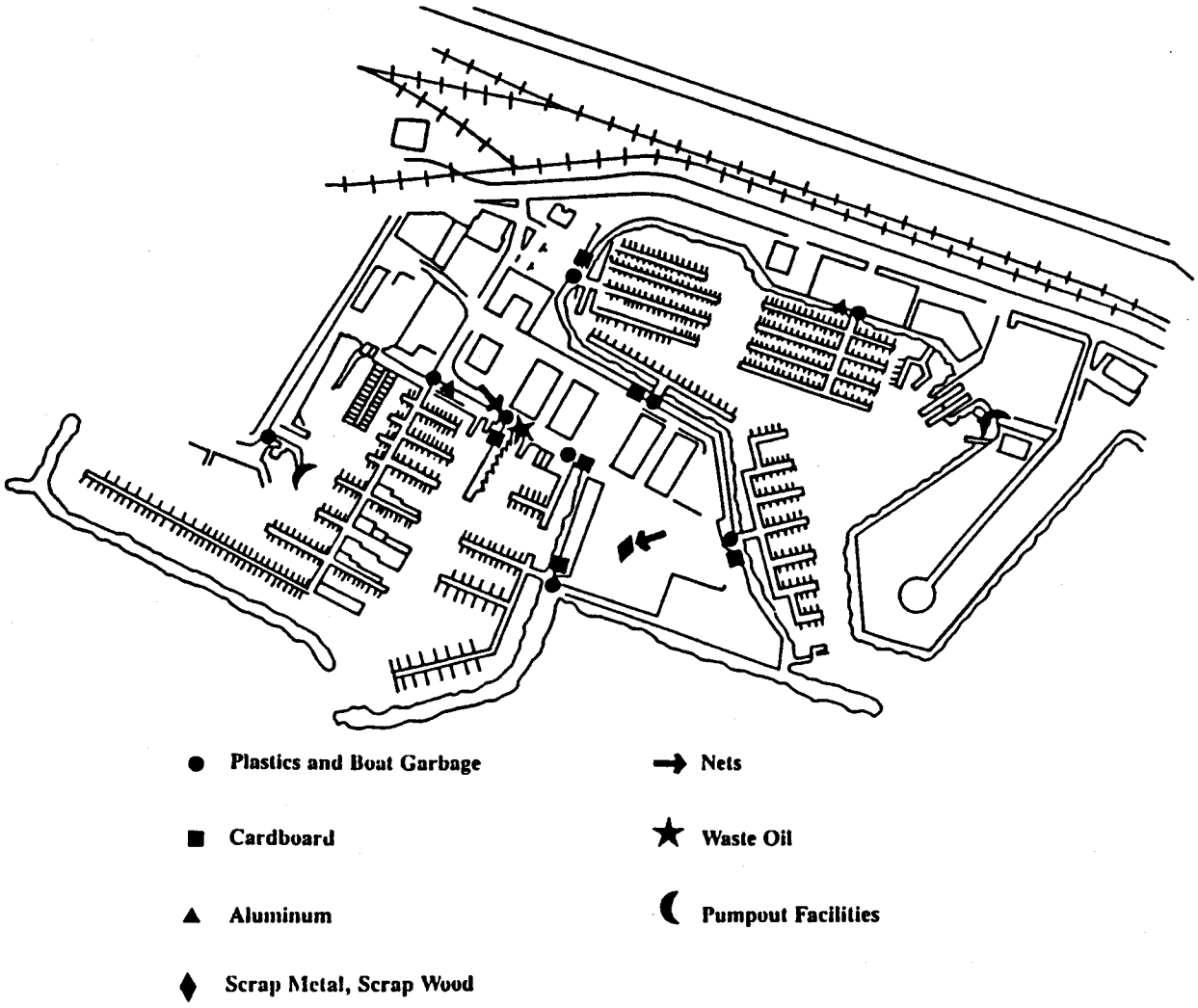

Figure 1.--Proposed waste collection facilities at Squalicum Harbor.

- Provide three aluminum recycling facilities at the harbor adjacent to the dumpsters used by the recreational boating fleet. Aluminum is a high value recyclable item, and these recycling revenues could help offset the cost of waste disposal.

The proposed facilities could be used by boaters and fishermen with a minimum of sorting. As a result, use of the facilities was expected to be heavy.

In addition, only materials that had ready markets were included in the recycling program. At no charge to the port, companies in the Bellingham area would pick up one or more of the materials being collected. This was expected to help reduce maintenance needs.

Glass was excluded from the recycling program for two reasons: 1) glass has a low market value and local companies would not pick it up at Squalicum Harbor, and 2) because of the weight of glass, specialized equipment would have been needed to handle it.

The Newport project found that blue color-coding of their recycling facilities was very useful, and the Squalicum Harbor project also color-coded the recycling facilities blue. Many fishermen and boaters travel frequently from port to port on the U.S. west coast and Alaska, and WSG suggests that for ease of recognition blue be adopted as the color for recycling facilities in all ports.

Educational Program

The educational portion of the program was multifaceted and involved working with the Washington State Task Force on Marine Plastic Debris. This task force had representatives from some 40 different governmental, environmental, industrial, educational, and community groups who worked together to develop a Washington State Marine Plastic Debris Action Plan (Washington State Department of Natural Resources 1988). As task force participants, WSG staff developed a logo for statewide marine debris cleanup (Fig. 2). This logo and the slogan "Get a Grip on Marine Debris" are being used throughout Washington State.

The educational portion of the Squalicum Harbor project also included developing and printing a marine debris poster; writing pamphlets directed at Squalicum Harbor boaters, commercial fishermen, and recreational boaters; providing presentations to various community and school (K-12) groups on marine debris; developing a liaison with Western Washington University's plastics technology program; and being available to the media on marine debris-related matters. Using these educational materials, WSG reached a total of 585 people at workshops and other meetings, and distributed more that 2,500 posters and pamphlets.

RESULTS AND CONCLUSIONS

The analysis and proposal conducted by WSG staff were provided to the Squalicum Harbor staff much the way a consultant would provide information.

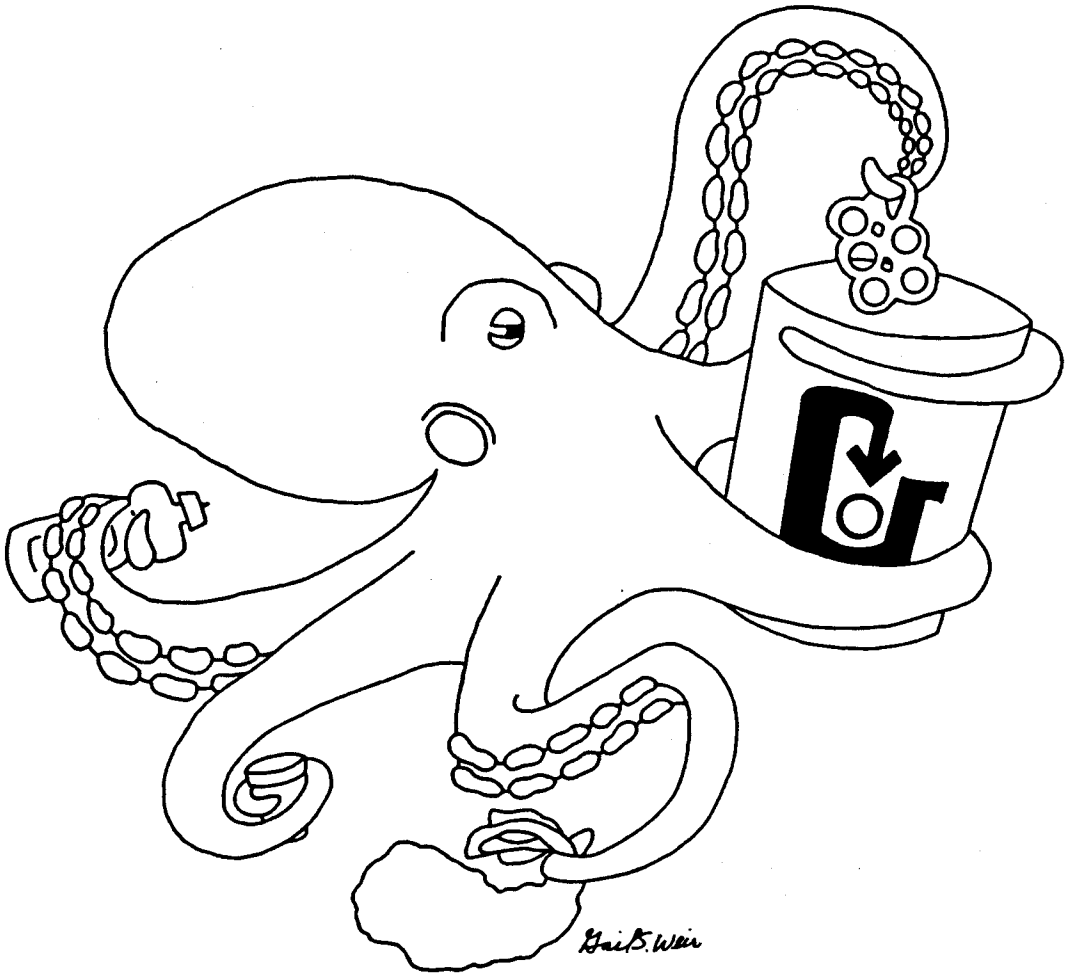

Figure 2.--Washington State marine debris logo.

However, the Squalicum Harbor staff had to make the actual changes. Six months after receiving the recommendations, they were just beginning to implement the physical changes. The first cardboard collection boxes were installed in early March 1989, and they were immediately used by the boaters and fishermen. The installation of the other facilities were expected to occur shortly thereafter.

We can only theorize about why implementing the proposal took so long. First, the Squalicum Harbor staff appeared to be already working at their maximum level. When a staff is already working at or near capacity, a new project is difficult to start. Second, in spite of the analysis and proposal, the staff appeared reluctant to implement the project for fear of generating more maintenance work for themselves. Third, this project may

have been viewed with some resentment because it was promoted by people outside of the Squalicum Harbor staff.

Because of the time it took to have physical changes made at Squalicum Harbor, no measurements have yet been made on the effects of the changes. This project points out the difficulty of setting up a demonstration project as an "outsider," and should caution others to expect to go slowly in similar projects.

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MARINE DEBRIS: NORTH CAROLINA'S SOLUTIONS THROUGH EDUCATION

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ABSTRACT

North Carolina began its campaign against marine litter in June 1987. The success of the program has been due largely to an emphasis on interagency cooperation and on education of the public. Five cooperating state agencies have been the University of North Carolina Sea Grant Program, and North Carolina Division of Coastal Management, Division of Parks and Recreation, 4-H, and Office of Marine Affairs. Educational activities have included slide programs given by a Sea Grant marine education specialist to power squadrons, fishing clubs, school groups, and service clubs, and ongoing exhibits and talks on marine debris by the state's three coastal aquariums. The program has also stressed youth-oriented activities relating to marine debris.

INTRODUCTION

North Carolina has nearly 560 km (350 mi) of coastline and 931,500 ha (2.3 million acres) of estuaries, bays, and sounds. Without question, the beaches and coastal waters are vital to the aesthetics and the economy of the state.

But litter and plastics could change this.

That is why North Carolina began its marine litter program in June 1987. Now, 21 months later, the state can show evidence of change and the promise of regulations and educational programs that ultimately will help solve litter problems at the coast.

METHOD AND DISCUSSION

On one Saturday in September 1987 and another in September 1988, the state marine debris program held Beach Sweep, a 1-day coastwide cleanup. Over 4,500 volunteers came to the coast and picked up more than 54 metric tons of trash. The volunteer participation, the amount of litter collected, and the extensive media exposure for Beach Sweep were the result of educational efforts by program coordinators and volunteers.

In R. S. Shomura and M. L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, 2-7 April 1989, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFSC-154. 1990.

Interagency Cooperation

North Carolina patterned Beach Sweep after similar cleanups in other states, but organizer Lundie Spence, Sea Grant's marine education specialist, took a different approach. Like the director of a play, Spence pulled in talent from many of the state agencies to play different roles in Beach Sweep and the marine debris program.

The 1987 Beach Sweep organization committee was composed mainly of representatives from four state government agencies. They were Sea Grant, the North Carolina Division of Coastal Management, Division of Parks and Recreation, and Office of Marine Affairs, which oversees the state's three coastal aquariums. In 1988, North Carolina 4-H Clubs joined the committee.

Full cooperation and contributions of time, money, and services from each agency helped spread the word to thousands of North Carolina citizens.

For example, Sea Grant's Spence kept state government leaders informed of activities concerning marine debris. She sent information on marine debris and Beach Sweep through a Sea Grant newsletter to 2,000 North Carolina teachers, and she gave slide programs to power squadrons, fishing clubs, school groups, and service clubs.

Sea Grant's communications staff handled all of the major publicity for Beach Sweep. This included issuing press releases, writing features and newsletter articles, compiling press kits, and scheduling radio and television interviews.

The Division of Coastal Management took on other tasks. As the state's coastal regulatory agency, this division was able to work closely with the governor's office, legislators, the state's Coastal Resources Commission, and the Marine Science Council to garner support.

Parks and Recreation contributed manpower at the coast for the cleanups and helped with fund-raising and contributions of garbage bags and pencils for tallying data.

The three North Carolina aquariums offered staff that served as regional coordinators for Beach Sweep. Each aquarium provided special exhibits and programs on marine debris to tourists and other interested visitors.

As the state's marine debris program grows, an increasing number of state government agencies, private nonprofit groups, corporations, small businesses, and volunteers are participating.

Targeting groups of all kinds with coastal and environmental interests provides not only a rich pool of talent and services, but also an unlimited resource for ideas.

In this case, the more the merrier.

This year, Beach Sweep and the North Carolina marine debris program still operate with no major corporate funding. The shoestring budget has gotten a bit fatter, but the shoestrings are not yet long enough to help accomplish all of the goals. Therefore, interagency cooperation is even more important to help carry out a comprehensive educational program.

Public Education

Emphasis on Youth

A special emphasis in North Carolina has been placed on creating awareness for the state's youth. Within the school system, the state's marine debris program coordinators have worked with science, environmental, and gifted-and-talented classes. In this area, copies of the marine debris slide and talk program from the Center for Marine Conservation have been made available to the schools.

Teachers have found out about other reference materials through a special newsletter from Sea Grant. In response, children from the fourth to twelfth grades have written Sea Grant for information. This exercise gives younger children the experience of writing for and receiving information on their own. Taking this action is one more step toward increasing awareness by personal involvement.

The North Carolina aquariums, the state maritime history museum, and the parks and recreation system have offered special youth programs on marine debris. Typically, leaders give a short talk or slide show on marine pollution and then take the group out on the beach to collect trash. After 30 to 40 min, they stop and discuss their findings and reactions.

This program has been modified to assist Boy Scout troops at the coast in earning a badge relating to environmental awareness. One troop expanded the idea during Beach Sweep and separated its trash for recycling.

Another excellent idea for increasing youth awareness has been a permanent display on marine debris erected at the North Carolina Maritime History Museum. One panel of the display is just for children. On it are photos of volunteers during Beach Sweep, an award-winning 4-H poster concerning plastics, and a pad and pen for comments. Pages and pages of ideas and comments have told museum educator Patricia Hay that children's eyes are open to the problems at the coast.

Probably the most far-reaching involvement originated with the state 4-H Club. This national youth organization has programs in each of North Carolina's 100 counties. Within this structure, Beach Sweep was promoted through newsletters and electronic mail as a good community service project for its members.

In addition, 4-H implemented a statewide marine debris poster contest for youths ages 9 to 11, and 12 and older. As schools already employ many such contests, this gave the young people a different avenue. The 4-H Club raised $255 for cash prizes in each category.

Most importantly, 4-H and Sea Grant helped devise five activities for youths concerning plastics and litter. They are currently being used by 4-H Clubs and school teachers throughout the state. But since they are new, 4-H education specialists are still conducting tests on the usability and viability of these activities as a curriculum.

The five projects include:

1. Living labels. This icebreaker invites students to become aware of types of plastic items around them. Students either act out the item they have chosen or give 10 words describing it. Other class members try to guess the item.

2. Why do we use plastics? By listing different kinds of plastics we use daily and discussing them, young people gain a better idea of how much plastic is used and why.

3. How strong is a six-pack ring? Youths test the strength of six-pack rings and correlate this with their durability in the environment. The objective is for them to realize how little chance an animal or fish has of freeing itself after entanglement.

4. Can we make plastics disappear? By comparing degradable and nondegradable six-pack rings, youths

   a. understand the meanings of photodegradable and biodegradable,

   b. learn that most plastics are not degradable, and

   c. learn that plasticlike materials can be made degradable.

5. Turning trash around. By simulating paper and plastics recycling, youths gain a better understanding of the process of and need for recycling in our society.

Other

The Beach Sweep effort has helped make many of North Carolina's citizens aware of marine pollution. Each volunteer that attended the cleanup has seen firsthand what litter can do to our beaches and how he or she can help keep them clean. The social, environmental, and economic impact of cleaner beaches is affecting the behavior of tourists. And pollution has become a political issue because people are concerned.

Since our cleanup began, certain public beaches have been kept cleaner year-round. Municipalities added more trash cans to beach access areas, and some of them added to their cleanup crews. Also, North Carolina is currently considering legislation on degradable six-pack rings.

Public education has not stopped with Beach Sweep, however. Each of the involved agencies has initiated programs concerning marine debris.

CONCLUSION

With these projects and our other efforts, North Carolina has begun its fight against marine pollution. By working together and focusing energies on the state's youth, much has been done.

For the past 2 years, North Carolina Sea Grant has been part of a national Sea Grant marine debris network. Each of the nation's 30 coastal states has contributed toward educating commercial fishermen, teachers, boaters, and the public about pollution and its effects.

Until the problem is conquered, however, much remains to be accomplished.

DESIGNING EFFECTIVE EDUCATIONAL PROGRAMS: THE ATTITUDINAL BASIS OF MARINE LITTERING

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ABSTRACT

The worldwide concern with marine and coastal debris has sparked recommendations for various abatement interventions. Popular among them have been educational programs. Effectiveness of educational interventions directed toward changing environmental attitudes and behavior has, however, been found wanting, according to some recent assessments. It is argued that problems with educational abatement programs may stem from the lack of appreciation and lack of application of social science knowledge about the basis of environmental beliefs, attitudes, values, and human behavior which affect the environment.

Marine debris abatement efforts can be enhanced by basing them on social science knowledge in three relevant areas: 1) paradigms and the nature of environmental attitude formation; 2) the nature and constraints of the desired nonlittering behavior; and 3) research on attitude and behavior change, including recycling and land litter abatement. Each of these topics is reviewed, with recommendations about its application to marine debris abatement.

INTRODUCTION

At the conference on the topic of fisheries-generated marine debris and derelict fishing gear held approximately 1 year ago in Portland, Oregon, educational programs were assessed by one participant as the most popular marine debris abatement approach. He stated that they are "politically attractive, do not cost much and meet other favorable criteria." However, the author also noted that such programs "often have only modest effectiveness and lack permanence" (Alaska Sea Grant Program 1988, p. 7).

The thesis of this paper is that one of the reasons for the limitation of these educational programs is the failure to understand fully the human and social causes of the problem. It is proposed that this shortcoming is due to the limited participation by social scientists in addressing the

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problem. Physical scientists have assessed the extent and nature of the impact of marine debris. From this data base has evolved a determination that a "problem" exists. But the definition of the problem has remained too strongly physical because it lacks the additional perspective of environmental issues provided by the social scientist.

An example of this lack of appreciation of the social component of the marine debris problem is seen in the recommendations made by the Interagency Task Force on Persistent Marine Debris formed by the White House Domestic Policy Council. The task force recommended that 1) the (marine debris) problem be quantified, 2) the sources be determined, and 3) ways be found to reduce plastic debris from all sources.

The phrasing of the document suggests that the "source" of the problem is merely a physical location or use or particular economic activity seemingly devoid of human imput. Review of this and other documents similarly phrased revealed that there was a missing step in these recommendations. Simply put, the missing step is to ask, "Why do litter and debris exist in the marine and coastal environments?"

The goal of adding this question is to refocus the problem-solving to recognize that human behavior is the cause of the litter and debris and not just a "source." If the human nature of the problem is not addressed in the problem-solving efforts, educational interventions cannot be effective but appear as an afterthought because "something must be done." It is contended that answers to the question of why debris exists must be determined and understood before and if "ways [are to] be found to reduce plastic debris from all sources."

SOCIAL SCIENCE FINDINGS RELEVANT TO MARINE DEBRIS ABATEMENT

With the goal of addressing this issue of the human cause of marine debris, three relevant social science topics will be briefly examined. The three topics are:

1. paradigms and the nature of environmental attitude formation,

2. the nature and constraints of the desired nonlittering behavior in the marine environment, and

3. research on attitude and behavior change including recycling and land litter abatement.

Each of these topics is reviewed with recommendations about its application to marine debris abatement.

The Nature of Environmental Attitude Formation

Societal Paradigm

Members of a society share a common world view embodied in beliefs, attitudes, and values. This world view, frequently referred to as a

paradigm, emanates from the experiences of the members of the society and is functional to the society in that it supports the society's efforts to survive. While the paradigm does not necessarily answer important questions, "it tells us where to look for answers" (Babbie 1989). It also becomes the basis for choosing problems that can be assumed to have solutions (Kuhn 1970). When the existing paradigm no longer serves the members of society, it changes as the established agreed-upon paradigm is modified in favor of a new one(s).

Within each society, subgroups share paradigms useful for supporting their experiences and position in society. For example, different scientific disciplines have different paradigms as do other occupational groups. In order to understand the basis of behavior of members of a society, it is important to appreciate both the general world view of the larger society and those views of the subgroups about which you have specific interest. Both the general and the subgroup will be discussed below.

The paradigm common to the American society has been characterized as the "dominant Western world view" (Dunlap and Van Liere 1984), the "technocratic" paradigm (Drengson 1980), or the "human exemptionalist" paradigm (Catton and Dunlap 1980). This paradigm sees the relationship between humans and the environment as one in which humans utilize the environment for their betterment, even at the expense of the environment. Based on the Judeo-Christian heritage, this paradigm assumes a human superiority over other organisms bequeathed to humans by their special relationship with God. Contained in this perspective of superiority is the belief that any problems which befall the environment during its exploitation can be remedied by humans through technology. A society which holds this paradigm believes that it is exempt from conformity to the natural ecological laws because of its ability to overcome any environmental problems.

The American extension of this paradigm divides the environment into parts which are privately owned for the gain of the owner and parts which are publicly, or commonly, owned (Hardin 1968). The "commons" is shared for the betterment of all members of the society. However, as Hardin (1968) notes, such a common betterment for all becomes impossible once the ratio of the population to the environment surpasses its "carrying capacity." At that point the common good suffers as the individual benefits from use of the commons.

Industrial pollution and littering behavior represent the use of the common for the betterment of individuals and their economic interests. Belief in the right of individuals to so use the commons for their interest is an important belief contained in the American paradigm. Throwing something "away" means simply putting it into the commons when it no longer serves the person's needs.

The strength of this tenet within the western paradigm is evident when we consider the "absurdity" of the idea that all pollution, every single bit, should be totally banned from the commons. To paraphrase, what general societal support would there be for the total prohibition of environmental degradation in all commonly shared environments--air, water,

and public lands? The economic interests would argue that such a position would cause mass bankruptcies. Average citizens would also resist such a ban when they came to realize how it would affect the consumer-oriented lifestyle which has also evolved from the paradigm.

Discarding refuse into the ocean becomes an obvious extension of this paradigm. A series of studies done by sociologists Dunlap and Van Liere (1978, 1984) sought to determine to what extent such a degrading orientation toward the environment was linked to subscription to the western paradigm. In other words, does a person's belief in the dominant western paradigm affect his or her attitudes (and behavior) toward the environment? Van Liere and Dunlap (1980) broke the paradigm down into eight dimensions:

- support for laissez-faire government,
- support for the status quo,
- support for private property rights,
- faith in science and technology,
- support for individual rights,
- support for economic growth,
- faith in material abundance, and
- faith in future prosperity.

Three of these dimensions of the dominant western paradigm were associated negatively with the environmental attitudes scales they also developed. The greater the support for the following, the less the support for the environment:

- support for private property,
- support for economic growth, and
- faith in material abundance.

We may, thus, propose from these research findings that individuals who subscribe closely to the dominant western paradigm--particularly support for private property, economic growth, and belief in material abundance--will more likely not hold proenvironmental attitudes. If such proenvironment attitudes are not held, it is more likely that littering behavior, such as that which results in marine debris, will be exhibited.

An alternative paradigm is evolving as the current paradigm becomes less functional. The paradigm which would reduce the stress on the environment is called the "new environmental paradigm" (Catton and Dunlap 1980) or the "person-planetary" paradigm (Drengson 1980). This paradigm accepts the fact that humans are subject to the same ecological laws as other organisms, and when humans degrade the environment, they are not always able to repair it with technology.

A "paradigm shift" (Kuhn 1970) by the majority of the populace may occur more rapidly than might be anticipated given the escalating environmental problems. Recent political deliberations in southern California were directed at reducing air pollution conditions that are no longer acceptable. The proposal included restricting each family to owning one car and requiring that the family members work near where they live. A

recent proposal by the U.S. Environmental Protection Agency directed toward reducing acid rain indicated that the solution could come with a required dropping of interior household temperature during the winter. While the dominant western paradigm still prevails, the fact that "responsible, mainstream" public officials were making these proposals suggests that the paradigm is shifting.

Educational interventions directed toward antilittering in the marine environment can benefit from an awareness of the target population's paradigm. If it is determined that they subscribe to the traditional paradigm, efforts toward modifying their world view should be included in the communication along with the message directed toward the specific change in littering behavior. If on the other hand, they are shifting their paradigm, then the communication can benefit from "tapping" this new orientation in the message.

Subgroup Paradigms

Besides the general societal orientation toward the environment, subgroups of the population have been found to vary in their attitudes toward the environment depending on their relationship to it. Awareness of these subdifferences can also benefit educational interventions directed at target populations.

For example, Louisiana has both the most active offshore oil extraction activities in the United States and some of the most prolific spawning grounds for fish and shellfish in the United States. Thus, coastal users include large groups of fishermen and offshore oil rig employees. Should we expect to find these groups different in their attitudes toward marine littering or the same? Popular opinion might argue that the oil rig employees would be likely to have less concern for the environment than fishermen whose livelihood depends on a healthy environment.

Research findings, however, suggest the contrary. Rural residents have been found to be less proenvironment than urban residents because they work in agricultural and mining activities which approach the environment in a more utilitarian, exploitative fashion (Lowe and Pinhey 1982). It is thus likely that the fishermen and oil workers will be more similar than different in their environmental attitudes. Louisiana fishermen have a reputation for considerable littering, as do oil rig employees. They also have strongly resisted steps taken by the Federal Government to protect the environment, such as the requirement that they use turtle excluder devices (TED's) while shrimping to protect the Kemp's ridley sea turtles.

The exploitative orientation toward the environment of some jobs may not be the only influence which engenders human exemptionalist attitudes in those whose livelihood depends on the environment. Companies for which such individuals work may themselves have company "cultures" reflecting similar orientations. It may be more cost-effective to use the commons for refuse, and this belief is learned as employees learn what is expected of them on the job. Personal worker economic motivation to perform well on the job compounds their own inclinations to litter.

Other individual characteristics have been found to affect attitudes and behavior toward the environment. Small town residents appear to also be less proenvironment. Van Liere and Dunlap (1980) explain this observation with the "progrowth" orientation of small towns. Urban residents have, to the contrary, been found to be more proenvironment. Environmental deprivation theory is used to explain this finding: Urban residents experience higher levels of pollution and environmental degradation and can thus make a comparison between the existence and nonexistence of pollution, which results in developing a proenvironment orientation (Dillman and Christenson 1972). In addition, urban residents are more likely to appreciate a "social solution" to environmental problems because they experience control over their built environment (Lowe and Pinhey 1982). Thus, they are willing to accept the existence of a problem because they perceive it as solvable. Take for example the predominance of urbanites in the groups who are involved in the annual beach cleanups.

In addition to geographic location, education, race, sex (Sigelman and Yanarella 1986), social class (Buttel and Flinn 1978), and age (Hamilton 1985) have been found to predict attitudes toward the environment. Income has not been found so strongly associated (Constantini and Hanf 1972; Sigelman and Yanarella 1986). Van Liere and Dunlap (1980, p. 190), in summarizing the findings from numerous studies of social characteristics, indicate that the association between income and environmental concern is "quite ambiguous and fail[s] to support the hypothesized positive association." This ambiguity may be due to changes which are taking place in the way in which the less affluent view environmental problems. While they value the jobs that come from industry, which often pollutes, they are becoming more aware that the pollution from such activity often is discarded closer to their communities than to those of the more affluent (Bullard and Wright 1986).

Similar changes may also be occurring in some of the relationships found in the subgroups reviewed above. While fishermen may not have traditionally been inclined to be concerned with the environment, the depletion of the resource such as the threat to the Gulf of Mexico redfish population may also begin to change their orientation to the environment as well.

It is important that the educational interventions being developed to reduce beach and marine debris are oriented toward the expected attitudes which various target groups might hold toward the environment, and that support be given to maintain current information on the attitudes which coastal users hold so that the intervention is relevant to the orientation.

Characteristics of Nonlittering Behavior

In addition to appreciating the orientation which coastal users have toward the environment, it is important to understand the nature of the behavior which the educational program attempts to change--i.e., marine littering--and the meaning given to that behavior by those who do it. Conversely, it is also important to recognize the characteristics of the desired behavior--nonlittering--which make conformity to it more difficult than other environment-oriented behaviors.

Complexity of Desired Behavior

Nonlittering behavior in the marine and coastal setting contains both a "don't do" and a "do" component, making its successful implementation somewhat complex. It is desired that individuals not discard that which is no longer of value to them into the commons--i.e., into the water or along the beach. Then, it is desired that individuals maintain the item in their personal space--in their pocket, on the boat, on the oil rig, with camping and fishing gear--until they are able to discard it in an appropriate refuse-collecting device or area such as a trash barrel, dumpster, junk yard, or landfill.

Inconvenience

Nonlittering behavior in the marine and coastal setting is an inconvenience to the individual because the appropriate refuse-collecting device is frequently not in the immediate vicinity. It may be at the beach entrance, at a nearby gas station, at home, or, for larger items, at a special location requiring an even longer trip. The inconvenience is defined by the length of time the individual may have to maintain the item which no longer has utility within his or her personal domain--often extended if out at sea--and by the fact that it is occupying part of a very limited space--fishing boat, oil rig, freighter, camper.

Limitations of Social Control

Littering in the marine and coastal setting is frequently done when there are no other people around to observe the behavior. Or, if others are present, they are experiencing the same need--to discard no longer useful items taking up precious space. Or, the observers are strangers or at such a distance that the litterer can maintain his or her anonymity while violating the norms. This means that the behavior can frequently not be controlled by the knowledge that someone else is observing them doing something contrary to the norm, a manner in which much desired behavior is encouraged.

An anecdote demonstrates norm-control dynamics and the way a litterer can attempt to avoid them. Last summer on a Florida beach, I watched a well-coiffured, expensively dressed beachcomber with cigar in one hand and a soft drink can in the other stop on a crowded beach to dig a small hole in the sand with his toes. He deposited the empty soft drink can in the hole, covered it over, and walked on. This behavior suggested to me that he knew littering was against the norm. If, however, he could hide the object, he would be able to avoid the possible scorn of the onlookers or rationalize that he had not littered because the object was no longer visible--one of the most commonly mentioned qualities of litter being that it is an eyesore.

Impact Not Obvious

The effect which the littering behavior is having on the environment is not seen or appreciated by the litterer because the discarded item frequently disappears under water or sand. Even when it does not disappear,

the beach and the ocean are so vast that the ratio of litter to commons is miniscule. It is difficult to appreciate the significance of one Styrofoam cup tossed off an oil rig into a vast ocean. Or even a piece of fishing gear or the waste from an ocean-going vessel.

Implications for Behavior Change

It is argued that awareness of these particular qualities of marine and coastal littering and nonlittering behavior can contribute to the development of more effective educational interventions directed toward curbing such littering behavior.

First, awareness that there is a lack of a clear antilitter norm in the marine environment and a lack of critical observers to enforce whatever norm there is should reduce emphasis on norm conformity in educational programs.

Second, it would be expected that educational campaigns which present graphic evidence of the impact of littering on wildlife--such as the ones recently developed--would improve antilittering behavior. They would help the individual become aware of the impact on the environment of even one small discarded item, albeit seemingly insignificant and invisible when the littering act is committed.

Third, educational campaigns should be implemented in conjunction with strong efforts to provide very convenient locations for disposal of marine refuse.

Examples of the linking of education and convenient refuse disposal are available in the recycling efforts of some communities. One successful pilot community recycling program in Louisiana has stackable containers for curbside pickup clearly marked for glass, aluminum, and paper. The effort to conform is thus quite minimal.

Similarly, studies should be conducted to determine the most convenient refuse disposal configuration at beaches, boat launches, marinas, and harbors. Some disposal services might best be reached from the water so that refuse does not have to be carried onto land by hand. Also, litter bag dispensers could be placed at convenient locations near boat launches and docks to encourage convenient on-boat refuse storage. With such accommodating refuse disposal facilities in place, beach or dockside antilitter signs would be encouraging a more feasible behavior. Once the marine user is practiced in such nonlittering behavior, the behavior will seem "more natural" and such attention to convenient refuse disposal will not be so important. This would be a case of learning to cope with natural hazards (this hazard being to marine life) through participation, as proposed by Sorensen and Mileti (1987).

An example of such facilitating assistance has been tried with success at several Louisiana fishing rodeos. When registering for the rodeo, each entrant was given a trash bag, with a request that it be used and returned to the registration desk at the end of the day. Those entrants who returned their bags filled with the day's refuse qualified for a special drawing for

several significant prizes. The bags were donated, as were the prizes, in return for public recognition that the companies had performed the public service. While the prize component of the activity may not be conducive to continuing the behavior after the fishing rodeo (see below), it might not have a negative effect if the bag contained a recommendation to always take along a trash bag and if trash bags were conveniently dispensed at docks and launch sites on a regular basis.

Research on Attitude and Behavior Change Including Recycling and Land Litter Abatement

The third social science topic of relevance for improving educational programs directed toward marine debris abatement is the research on attitude and behavior change. Research has been conducted on the content of successful persuasion communication in general and on persuasion directed toward specific attitude and behavior changes. These include self-help behaviors related to health, safety, crime and natural hazards protection (see Weinstein 1987 for a useful review), and energy conservation, recycling, and litter abatement on land. A review of theories useful for attitude and behavior change with regard to solid waste demonstrates the utility of this literature.

There is little systematic theory concerning the social psychological variables which influence littering (Reich and Robertson 1979). However, several theories have been found to be useful in changing littering attitudes and behavior. These include reactance theory (Mazis 1975); cognitive dissonance theory (Weigel and Weigel 1978; Shipee et al. 1980; Cook and Berrenberg 1981) or balance theory (Winham 1972); saliency theory (Cook and Berrenberg 1981); and Bem's self-perception theory (Arbuthnot et al. 1976-77; Pedersen 1979; Pardini and Katzev 1984). Each of these theories explains behavior based on an assessment which people make about themselves or those around them.

Reactance theory asserts that "when a person believes himself free to engage in a given behavior and his freedom is eliminated or threatened with elimination, the individual experiences psychological reactance" (Mazis 1975). When this occurs, the planned intervention results in behavior opposite to what is desired. An example is the TED which has been so strongly resisted by shrimpers in the Gulf of Mexico. While preventing all resistance to the TED's would have been impossible, a greater appreciation of the likelihood of reactance might have engendered different approaches by the environmentalists. Likewise, by knowing what coastal users believe they are free to do in the coastal environment, litter abatement interventions can be developed which will be less likely to cause such reactance.

Dissonance theory also has potential utility. It proposes that dissonance may occur for individuals among various values and beliefs which they hold and observations which they make. When this occurs, a person tries to reduce the dissonance. A person might interpret the observation such that it supports values and beliefs already held. Such dissonance may exist for the marine and coastal user with regard to littering. By determining whether it does, educational programs can be developed encouraging certain attitude and behavior change to "assist" coastal users in reducing their dissonance.

Saliency theory applied to conservation behavior "impl[ies] that the salience of proconservation attitudes will be enhanced primarily through or in anticipation of associations with others" who share proconservation attitudes (Cook and Berrenberg 1981, p. 82). When such persuasions are implemented, the presence of those holding nonlittering attitudes would be likely to increase saliency. Their presence can also be felt by presenting their proconservation statements in their absence or by asking residents to make public commitments to proconservation behavior. Beach cleanups are an example of a way to enhance the saliency of nonlittering behavior. Individuals make a public commitment to proenvironment behavior in the presence of other like-minded individuals.

Likewise, Bem's theory of self-perception can be applied to changing marine littering behavior. Bem proposes that behavior change occurs after a person changes his or her self-image to one capable of the new behavior (Arbuthnot et al. 1976-77). This self-image change can be assisted by educational programs that require small behavior change commitments to start the process of self-image change. Arbuthnot et al.'s successful experiment required minor recycling commitments which then led to a willingness to undertake more extensive recycling. Refuse disposal such as recycling at marinas and harbors could be approached in such an incremental way. Based on this theory, educational programs which encourage refuse disposal by giving prizes would not be expected to work over the long run because individuals do not have to change their self-image. The motivation to dispose correctly remains external to them, i.e., a prize given by someone else.

CONCLUSION

It will not be easy to integrate even the few concepts and theories presented in this paper in addressing the marine debris problem. It will be even more difficult to determine and apply the appropriate theories when social science research on relevant topics is more thoroughly reviewed. However, motivation to address the existing research and to respond to it can be found in recognizing the difficulty of success with educational programs in light of resistance from the existing human exemptionalist paradigm. Human behavior is the result of very complex social psychological processes influenced by the structure of the society in which the person lives and his or her position within that society. To have a modicum of lasting success in behavior change, "one needs all the help one can get." It will require a cooperative effort of both physical and social scientists to provide the knowledge base needed by those working directly with the marine debris problem to address its solution in a timely and successful fashion.

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